The Independent Magazine for Users of Heath/Zenith Microcomputers

SEXTANT

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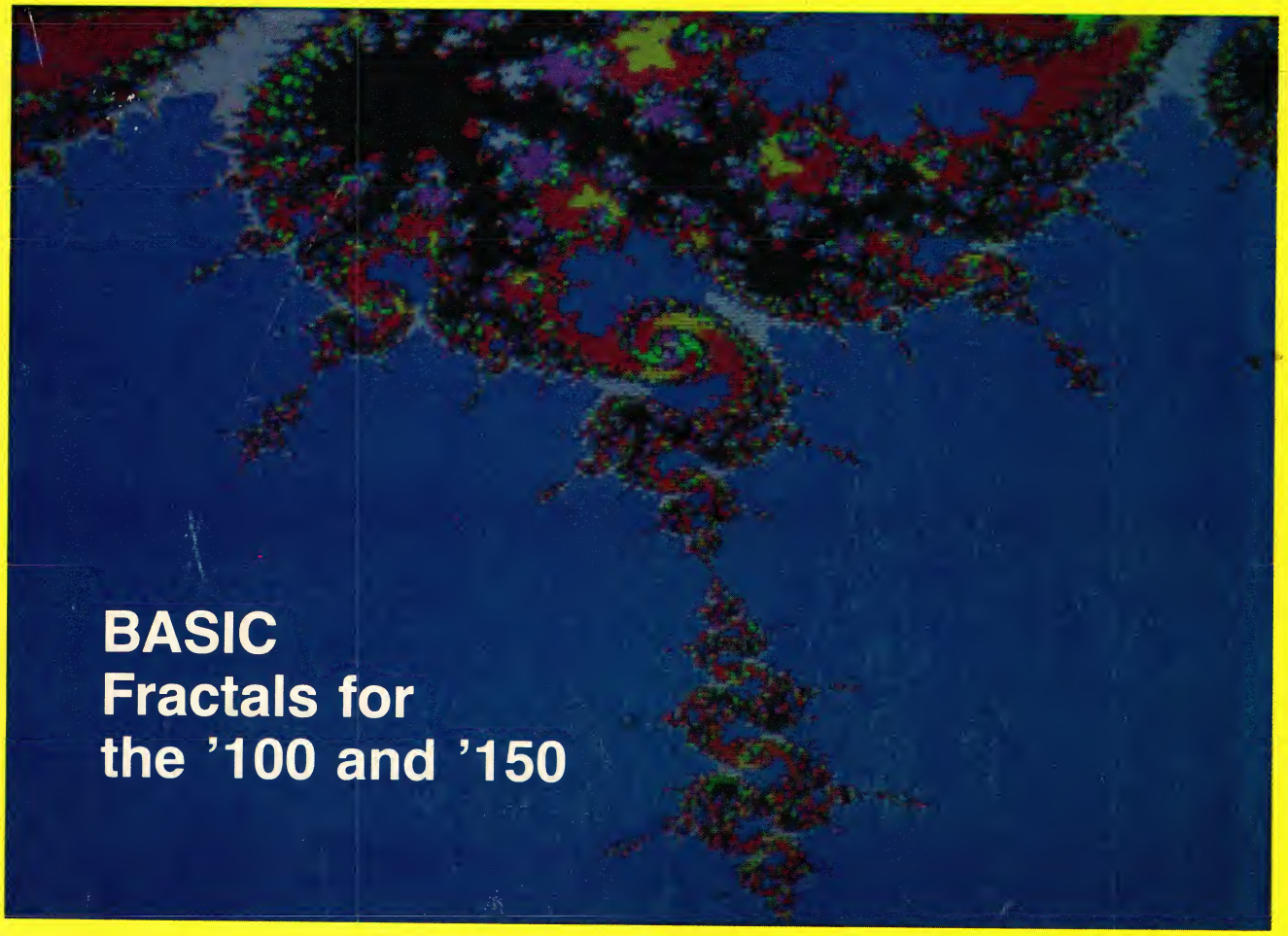

BASIC Fractals for the '100 and '150

1216K RAM for Your '151

A Low-Budget Data Base for HDOS

Add More 5¼" Drives to Your Z100

FBE Research: A Former Boeing Engineer

SEXTANT

Photo courtesy of FBE Research

9 FBE Research Company has produced enhancements for the H8, H/Z89-90, H/Z100, and H/Z150-160. How'd it all happen and who's behind this world-class independent vendor to the Heath/Zenith community? For the answers, let's meet Dave Brockman—up close and personal.

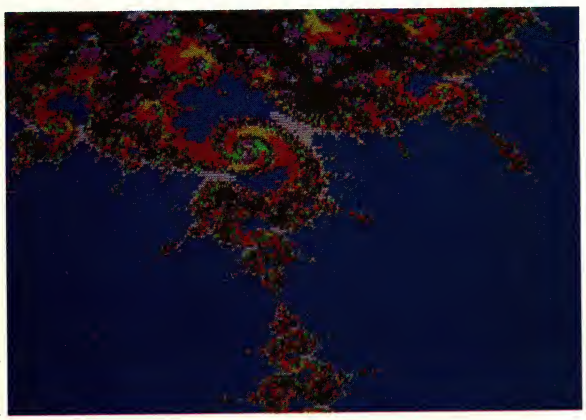

Photo by Charles Floto

76 We don't encounter very many regular polygons in nature. Yet that's what we usually get with computer graphics. If you're ready for more complex shapes, type the BASIC program described here into your Z100 or Z150. You, too, can be on the cutting edge of computer graphics.

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Microsoft Word, Version 2 17
Freddy Sweet
If you're running version 1 of Microsoft Word on your H/Z150-160 or H/Z200, maybe you should move up to version 2. It has a lot more to offer—but there's still plenty of room for improvement.

Adapt Your Soft-Sector Controller to Use Hard-Sectored Disks 25
Ray Albrektson

Z100 Notebook 33
William N. Locke
Version 3 of MS-DOS adds support for local area networks. Does it have anything else to offer? Meet some of its new commands. The Notebook also records some initial experiences with an EasyPC. And it includes some software to get you started flipping the pages of your Z100's video display.

From FBE: 1216K RAM for Your '151 39
Richard L. Mueller
If you're still making do with 320K or less memory in your H/Z151-161, MegaRAM-150 might be just what you're looking for. It offers several options for memory expansion—all the way up to 704K for MS-DOS plus a 512K RAM disk.

A Low-Budget Data Base for HDOS 47
Robert L. Schlessman
For $30 you can get a bare-bones data base that runs under HDOS. It even allows you to spread your information over multiple disks. Of course, it does have a *few* limitations.

C Notes 52
Joseph Katz
Release 3 of Ecosoft's compiler for MS-DOS really shines. Two other suppliers provide inexpensive libraries of usable functions. Four lines of code provide a screen dump for the Z150. Meet the Seidl Make Utility and two C interpreters for the Z150. And here's the latest installment of a polished WordStar-to-ASCII filter.

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Meet a full-screen editor that takes up only 7K of CP/M's valuable memory space. A survey of public domain communications programs begins with consideration of Ward Christensen's MODEM. Updates on Write-Hand Man and GEnie. Reading the mail and commenting on gripes. They're all part of the 8080, 8085, and Z80 regions of Heath/Zenithdom.

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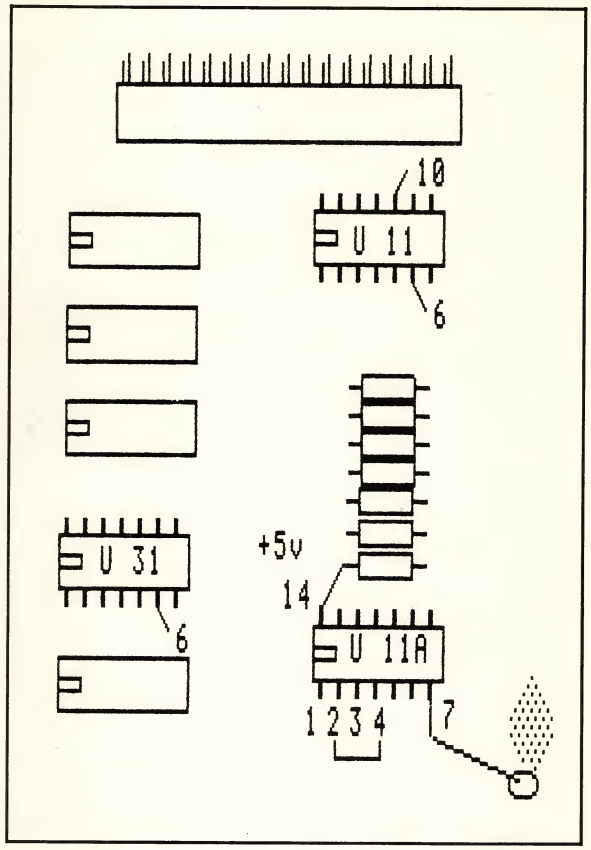

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Every other Heath/Zenith computer can support more than two 5¼" disk drives. This article shows you how to modify MS-DOS to get your H/Z100 into the club. With a small addition to the disk controller, you'll even be able to mix 48 track per inch and 96 t.p.i. drives.

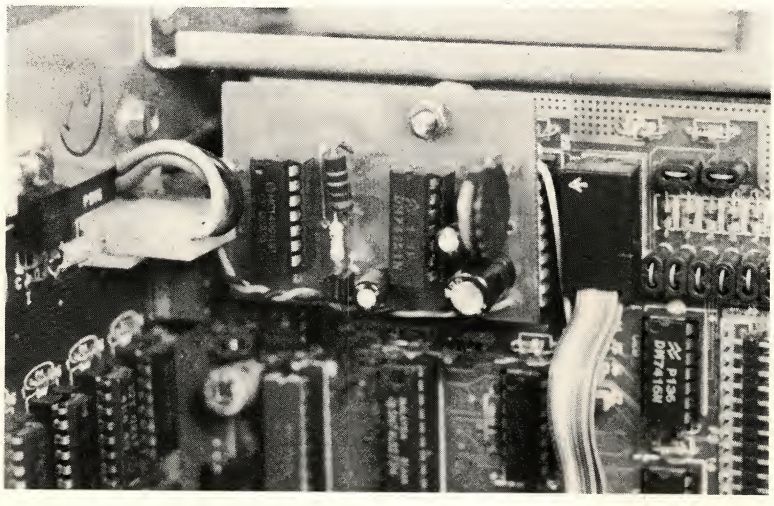

Photo by Ray Albrektson

25

Got some ten-sector disks left over from the days before you moved up to the higher capacity of a soft-sector disk controller? This article gives you a circuit that'll ignore all those extra holes in your old disks and allow them to store some new data.

The Editorial Eye

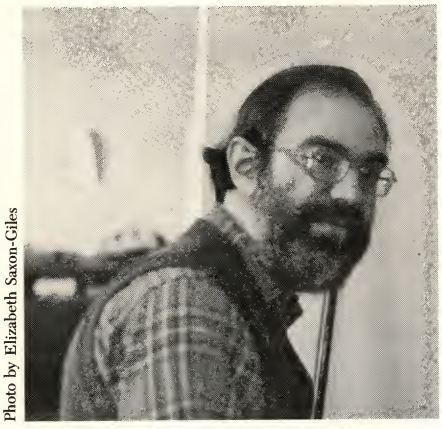

Photo by Elizabeth Saxon-Giles

I've been somewhat amused to witness the rejoicing in the general microcomputer press over the demise of copy protection. Once more, computer publications are heralding a revolutionary advantage that's been available for several years in the Heath/Zenith community.

One major question for the rest of the world is how much longer Lotus Development Corporation will cling to copy protection. Meanwhile, I've been using an unprotected version of Lotus 1-2-3 on my Z110 since September 1982.

Many publications have repeated the old advice that a prospective computer owner should shop for software first, and then find the hardware it would run on. But I haven't seen any recommend that the way to avoid copy-protected software is to buy Heath/Zenith hardware. I guess they just weren't paying attention to computers produced in Michigan.

Perhaps it's just as well. The obscurity of the Heath/Zenith line has allowed us to avoid the type of computer user who thinks it's the height of cleverness to copy a floppy disk rather than pay for the right to use a commercial software product. The sophistication required to discover that Zenith sells computers seems to go along with moral maturity. Many of those who build Heathkits build programs as well, and can appreciate the difference between writing software and copying it.

And most of those who have been in charge of selling software to our community have actually had some experience as software users. They know how much copy protection inconveniences honest users. Many of them have been willing to bet that customers who were treated like honest adults would act like honest adults.

Heath/Zenith has made hundreds of thousands of dollars of up-front payments to publishers for the right to distribute major software products without copy protection. Microsoft and Lotus weren't risking much, since hardware incompatibilities prevented their software from leaking out of the Heath/Zenith community into the rest of the marketplace.

Now that the general marketplace has matured, more and more publishers are forsaking copy protection. Perhaps enough customers have caught on that if you don't want it, you shouldn't buy it. This is a fortunate development for Heath/Zenith owners unfortunate enough to own a computer that's compatible with the rest of the world.

Personally, I'm just smiling at how long it took them to catch up with us. And at how much they're celebrating now that they're finally here. It reminds me of the media acclamation over Apple's discovery a few years ago that the alphabet has 52 letters, not 26. And that a computer screen should be 80 characters wide, not 40. And that a numeric keypad might be a nice thing to have. The people who designed the H19 terminal were way ahead of them.

Charles Floto

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Letters

Long live "The Eight-Bit World"

I was quite tickled to see your new 8-bit column starting up. I'm twice as pleased as I have two H89s and plan to keep them for some time to come. Although I can appreciate the problems of trying to publish articles relevant to the myriad of hard- and software products available, perhaps the H8 and H89 deserve a little extra effort because of their pioneering positions in home computer development.

Heath has traditionally leaned towards the hobbyist, though one unfortunately cannot expect this to continue. Already the computer products available seem to be capable of much more than the "average" home user might need. I don't see much left to fill the gap of the home user, if such a gap still exists. Once again the American consumer seems to place more interest in the fastest, biggest and brightest rather than what is actually needed. Remember 425-hp cars and 500-watt stereos?

At work and in my own business, I constantly see individuals touting their state-of-the-art computers while they only use a fraction of their equipment's power. When an RBase 5000 manual is two inches thick, it is quite easy for one not to get deeply involved in it for just occasional use.

So, long live your new column (and state of mind?). I sincerely hope you will find it in your interest to continue to support those of us who are computer-literate enough to admit that we often don't need all of the technology that is available. There are more of us out here who think like that than will admit it.

William M. Raisner
Calimesa, CA

"Whiz-bang" machines necessary?

Congratulations are in order to Mr. Walter J. Janowski and the editorial staff at *Sextant* for recognizing the need for and publishing the new column, "The Eight-Bit World." Mr. Janowski has accomplished what you were, heretofore, unable to do—convince me to maintain my subscription. For the last few issues, the main attention getters in *Sextant* were, for me, the advertisements for eight-bit hard- and software, and these, I think you will admit, are starting to get a little repetitive. I sincerely hope that Mr. Janowski will be literally flooded with letters indicating the true interest level in the Heath/Zenith eight-bit world.

As an aside, I believe that most of your readership recognizes that technology continues to improve and that these improvements will generate newer, faster and ever more capable machinery. Fortunately for our competitive free-enterprise society, someone will be able to not only afford these added enhancements but also simply desire to have something better than they have now. If, however, one could poll the home computer user community and assess the uses they make of their machines, I am confident that the results would indicate at least 80% of the machine hours are spent in word processing and simple data base management functions. The next obvious question is why do we need the newer "whiz-bang" machines? I certainly like to read about them, but not to the exclusion of information that I can actually use. Is it time for another poll of your readership?

Thanks for a well done magazine, and I hope that I have convinced you to include more eight-bit material.

H. B. Wynne
APO New York 09083

. . . and from a '120 user

Since lots of other people tell you all how to write your magazine, I will put in my two cents' worth also. I have an H120 with some upgrades and a HERO Jr. robot. I feel the articles should be targeted toward the computers that are not copies of lesser machines. There are several articles in every issue that have information I can directly apply or use in some way. Thank you for a great magazine.

Steven D. Semon
Sedalia, MO

ZCLK news and an S-BASIC reminder

There is "some good news and some bad news" about ZCLK ("Keep Your '100 Timely and Up to Date with ZCLK," *Sextant* #22, May-June 1986): We installed a ZCLK in our Z100 in the fall of 1984 (!), and were very pleased with it. The bad news is that we had to pull it out when we installed the Gemini board some months later. It goes in the same area, and there is just no way for the two products to coexist in the computer.

The good news is that in a recent conversation with Dave Brockman, president of FBE Research Co., Inc., the ZCLK vendor, he told me that a new version of ZCLK *will* be usable with the Gemini board!

I am amazed and amused at the frequency of articles about getting rid of line numbers in BASIC ("Z-BASIC Z-BASIC Preprocessor: Programs Without Line Numbers," *Sextant* #22, May-June 1986). Most describe either complicated procedural methods, or "ad hoc" translators which are themselves written in BASIC (and are therefore sloooow . . .). Your current article falls into the latter category.

If you really want to combine the advantages of Z-BASIC with the features of a modern programming language, such as no line numbers, named subroutines, modern control structures, the ability to include other files, etc., you should use S-BASIC, which is both a programming language and a fast, machine-language translator. It was written by my colleague Bill Clarkson, and is available for HDOS, CP/M, Z100 MS-DOS, and Z150 MS-DOS from Sunflower Software, Inc., 13915 Midland Drive, Shawnee, KS 66216, 913/631-1333. All versions are $49.95 plus $2.00 for postage and handling (Kansas residents add sales tax).

S-BASIC was described in the article "Put Some Structure in Your BASIC Programming" in *Sextant* #2, Summer 1982!

Joseph P. Smedley
Comptographics
Hawthorne, CA

An alternative to patching

Re: "Patching Away the WordStar Wait" (*Sextant* #22, May-June 1986):

For those who aren't up to patching their copy of WordStar, or have a different version, there is an easier way to cut down the waiting time for the copyright message.

Just after you input the "WS" command to bring WordStar up, input any of the "No-file" commands. You can type "D" to open a document, "H" to change the help level, etc. The copyright then only stays on the screen for about three seconds instead of ten.

Happy editing!

Robert J. Buch
Enterprise, AL

ZCLK modifications

I have been using the ZCLK since Dave Brockman of FBE Research first came out with it. In fact, I purchased it directly from him before it became an exclusive Heath product with the considerably higher price tag, but now the price is coming back down to a more reasonable level. It's great for us lazy people who just can't force themselves to enter the date and time on boot-up.

However, when I installed my EasyPC system board, I was unable to use that clock module because it physically conflicted space-wise. With Dave's sugges-

tions, I have been able to modify my ZCLK to be compatible by installing a 40-pin dip-to-dip cable one foot in length so that I could sit the clock in the open area in the front left corner of the computer. Unfortunately, the hard part involved the fact that the direct plug-in header arrangement doesn't work in this configuration. Just removing the header and plugging the cable into the socket on the bottom of the module would actually reverse the pin arrangement, so I had to de-solder that socket from the bottom of the clock board and re-solder it to the top. Then the cable pins matched on both ends. I was pleasantly surprised that it not only worked in the Zenith mode, but the same software also worked in the IBM mode. This same hardware fix should work for the Gemini board combination, but I don't know that the software would also work in their IBM mode.

Bob Gray
Graymatter Application Software
Norristown, PA

Tired of IBM PC this and PC that

I am a Heath H8 user, and I have devoted the last five years to building up my system from a simple front-panel input-to-cassette system to the dual double-sided/quad density CP/M system I'm working with now. I have brought my system to this level through a series of hardware and software updates which I did all by myself, without the help of any of the computer magazines I had subscribed to. I've subscribed to *Computers & Electronics* (when it was *Popular Electronics*), *Kilobaud Microcomputing*, *Byte*, and finally, to *Sextant*, and none of them filled my need for hardware or software articles—until now!

I was so disappointed when I received my first year's subscription of *Sextant* and not one article appeared in it that was about my H8. I felt as if I'd been abandoned once again. It seemed as if my search was in vain.

Then, when I read the new column in the March-April 1986 issue of *Sextant* called "The Eight-Bit World," I was so excited to have finally found a column that would support my system!

```
100 OPEN "R",1,"RANDOM.DAT",60
110 FIELD#1,10 AS A$,10 AS B$,10 AS C$,10 AS D$,10 AS E$,10 AS F$
120 OPEN "O",2,"SEQUENT.DAT"
130 FOR R%=1 TO LOF(1)/60
140 GET#1,R%
150 Z$=A$+B$+C$+D$+E$+F$
160 PRINT#2,Z$
170 Z$=""
180 NEXT R%
```

Listing A. (See "SORTing random-access files," below.)

The column started off real good by informing readers that just because my system has an 8-bit Z80 CPU in it, and not a 16-bit 8088 (like IBM and clones), that doesn't mean it is obsolete! I've gotten so tired of reading article after article about PC this and PC that . . . .

I was also glad to learn about some public domain software that is available for my system that would be useful to me. I hope that in the future readers who own H8s and H89s will be able to exchange notes and ideas through this column about what they have done to and with their computers to make them better. My thanks to the author for this long-overdue column. Keep up the good work! Hope to see your column in the next issue also.

Mr. Floto, please take note: future subscriptions may depend on the survival of this column!

Walter E. Anthony, Jr.
Houston, TX

SORTing random-access files

I would like to expand a bit on Alison Phillips's discussion of the use of SORT.EXE, in the "Z100 Notebook" of issue #21 (March-April 1986).

Mr. Phillips does not specifically state what kind of data files are SORTable. The example he used was (inferentially) a text file. SORT will also work with a sequential data file, but not with a random-access file. SORT apparently regards a random file as one large string, and gives the whole thing back to you unchanged.

However, it is a simple matter to convert a random-access file to a sequential file using a routine similar to that given in Listing A.

[Once you perform this routine,] you can sort SEQUENT.DAT with:

TYPE SEQUENT.DAT|SORT/+11

(which screens a sort on B$) or

SORT/+31 <SEQUENT.DAT >PRN

(which prints a sort on D$).

In the latter line, the space between . . .DAT and >PRN is obligatory, at least with IBM or Z150 formats.

You can add delimiters between the random fields in line 150, or add SPACE$(X)s between the fields to improve readability of the output. If you add delimiters or spaces, remember to change the column numbers accordingly. You can also re-arrange the order of the fields in line 150 so that the field to be sorted can be first in the printout.

I often include in my programs a subroutine such as Listing A that automatically creates a sequential file each time I change a random file, if I think I might be doing some sorting.

Robert Hanan, M.D.
Oxnard, CA

CP/M is faster

I have just finished reading the May-June 1986 issue and have found it to be the most interesting and informative issue in a long time. It just seemed to address some issues I have been pondering. I especially enjoyed the "Z-BASIC without line numbers" article. I would use it, except that it would add an extra step and time to my compiling process.

I am also glad to see you have "The Eight-Bit World" column. I started on the Z90, but currently have three Z100s. I wrote a filter program which converts CP/M BASIC source to MS-DOS BASIC

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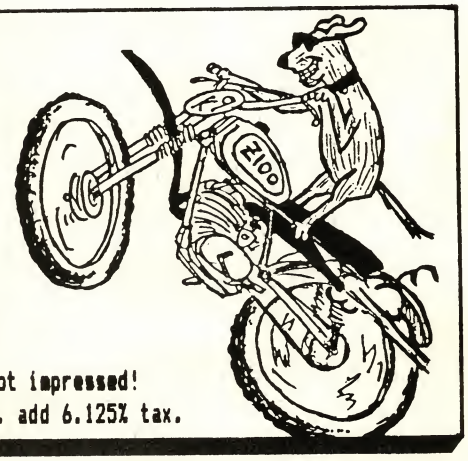

Circle #216 on Reader Service Card

source in the hope of converting all the systems I have written into MS-DOS. Basically, the only differences in my programs were in clearing the screen and locating the cursor.

However, I still run 99% of all my programs using CP/M. Why? It is faster. My programs are heavy on disk I/Os, and CP/M runs in half the time on my two floppy-disk systems. I was amazed!

I have tried tweaking my system, using some of the suggestions made in your magazine. While throughput has improved, MS-DOS still takes twice as long. So, unless MS-DOS is improved in its disk handling, please keep us CP/M users informed.

John H. Mosow
Lincoln, NE

Solving the storage problem

Mr. Rich Downer's problems with the size of the environment and the full 20-meg hard disk are easily solved ("Letters," *Sextant* #22, May-June 1986).

I assume he is using his entire hard disk as a C: drive, and the Zenith version of MS-DOS 2.1. Further, he appears to write a lot of small files. Unfortunately, the 2.1 version of MS-DOS stores all files as a minimum of 8K even if the file is only 1 byte. This, of course, is utterly wasteful. By partitioning the drive into four drives, C:, D:, E:, and F:, with one drive just below 8 meg and the remaining drives as 4 meg each, he will save an enormous amount of space. On drives of under 8 meg, files are stored as 4K files; on drives of under 4 meg, files are stored as 2K.

Partitioning has its drawbacks, however. One has to remember on which drive the programs are stored, and PATH can be long and complicated.

The simplest way to solve the storage problem is to upgrade to PC-DOS 3.1 or 3.2. When using a 20-meg hard disk, files are stored as 2K. Furthermore, programs to set the environment size in 3.1 and 3.2 can be found on many bulletin boards.

The use of PC-DOS works well with the Zenith 150, and it is substantially less expensive than the Zenith MS-DOS version. The list price of PC-DOS 3.1 is $90; 3.2 is $95 and worth the extra $5. Both can be bought through mail order houses at a discount. Zenith MS-DOS 3.1 lists for $150, and discounts are not available, other than the standard HUG discount.

Judson H. Spencer
New York, NY

Continuing eight-bit support

We were delighted to see the premiere of the column "The Eight-Bit World" by Walter J. Janowski in issue #21. All of the other H/Z-related publications that we are familiar with have dropped coverage of 8-bit systems. Since neither of us own 16-bit units, we have dropped our subscriptions to them.

Our "old" H8/H19/H17 combination is very reliable; we have no intention of "upgrading" to an IBM-clone system.

We feel abandoned by the rest of the H/Z world, but as long as *Sextant* publishes information on our machine, we will continue to subscribe.

Thanks for the continuing support.

Walter M. Scott, III
Karen D. Morton
Knoxville, TN

Please send letters to: Editor, Sextant Magazine, 716 E Street, S.E., Washington, DC 20003. Letters will be edited according to style and space requirements. Due to the volume of mail received, we are unable to print or respond to every letter we receive.

Coming Up in *Sextant*

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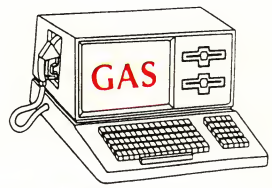

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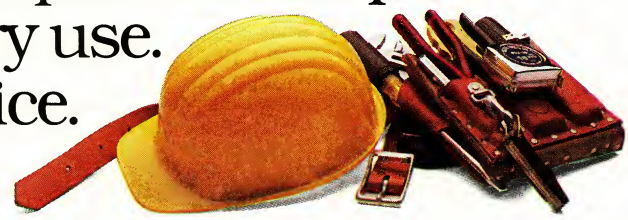

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FBE Research: A Former Boeing Engineer

Dave Brockman got a good price on a printer that wasn't quite compatible with his H89. Making them work together led to providing support for thousands of users of '89s, '100s, and '150s.

Peter Ruber

D. M. Brockman and his FBE Research Company of Seattle have been an active force in the manufacture of product enhancements for Heath/Zenith computer systems for a number of years. Dave's first products were for the H8 and the H/Z89; his latest ones have been for the H/Z100 and the H/Z150.

I'll have to admit I've become a fan.

My initial contact with Dave and FBE was the result of my interest in reviewing one of his products, Spooldisk 89. (See "Spooldisk 89" in *REMark*, May 1985.) Spooldisk 89 gave me a versatile printer interface, an "electronic disk" that held 128 kilobytes, and a spooler that would let me get back to work on my '89 while it printed out my files.

Shortly after I started working with the board, I had a few questions. So, I picked up the phone and pestered Dave with some questions. It turned into a marathon conversation that burned up Ma Bell's wires cross-country. We seemed to hit it off, so to speak.

We called one another frequently and exchanged voluminous letters. It is from these conversations and letters, and finally interviewing Dave in person last fall, that I've pieced together this question-and-answer session.

Photo courtesy of FBE Research

The inner sanctum at FBE—what Dave Brockman calls the 'room of a thousand computers.' You could tinker around here for months without being conscious of the passing of time.

A quick look back

I've never known Dave's designs to fall into the "me-too" category. They're often unique and interesting boards that achieve useful and practical results for their users.

For those of you just meeting FBE, and for those of you who might have forgotten how long Dave's been around, a quick review might be in order.

1967 Dave Brockman, an engineer at Boeing.

1975 FBE Research Company, starting as part-time, "outside" work in computers.

1980 CT.DVD, Dave's first program for a Heath/Zenith computer. This was a device driver written to let the H/Z89 computer running the Heath Disk Operating System (HDOS) talk to a Centronics printer.

1981 The H89CTI board, a parallel-printer interface board for the '89.

1982 The H89UTI Utility Card, a multi-function board for the '89; among other things, it gave the '89 added interface capabilities and additional random-access memory (RAM).

1982 The H89RAM board, a 16K memory-expansion card.

1982 The H8CTI board; a parallel interface for the H8 computer.

1983 H89PIP Parallel Interface Port, the successor to the H89CTI board.

1984 Spooldisk 89, which introduced my '89 to FBE.

1984 Slot 4, a plug-in board that provides a fourth expansion slot on the right side of the '89.

1984 ZCLK, a clock/calendar board for the H/Z100.

1985 ZMF100, a memory-expansion modification for the '100. Two small cards plug into the '100 to allow it to use the newer 256-kilobit RAM chips as well as the 64K chips that came with the machine.

1985 It's a full-time operation.

1985 MegaRAM-150, memory expansion for the H/Z150 and '160 IBM-compatibles; a new FBE chip replaces the memory-decoder chip, allowing the '150 to use 256K memory chips and gain a memory disk, as well. (The MegaRAM-150 is reviewed elsewhere in this issue. See Richard L. Mueller's "From FBE: 1216K RAM For Your '151.")

1985 ZP640 and ZP704, memory decoder chips to let the '150 take 256K chips (to go up to 640K and 704K RAM, respectively): now combined into the ZP640 Plus.

Peter Ruber owns a contract food management firm. He has written and edited several books; he's also written many computer-related articles. Though he owns nine different computer systems, he prefers the H89 over the rest.

And besides all that, FBE has been the source of various pieces of support software and other work that would make this chronology altogether too long. It's time to meet Dave.

From Boeing to businessman

Meeting Dave for the first time is a dwarfing experience for an interviewer. He's six feet, eight inches high inside a 300-pound frame. He's a kind of Hulk Hogan in high-tech land, who is fond of what he refers to as "mind-rot" science fiction and a 1973 Porsche that he must surely need a giant shoe horn to get into.

****

You spent eighteen years at Boeing. What made you decide to leave and devote yourself full-time to FBE?

Well, thanks to the success of our ZCLK board, which is distributed exclusively by Heath/Zenith, our business had grown to such a point that I could no longer regard it as a part-time endeavor.

I was also feeling claustrophobic after so many years. Boeing had become such a huge conglomeration of separate divisions, and the really exciting projects had become team contributions rather than individual effort. I'm afraid I'm too much of a loner to accept this kind of regimented way of life. FBE's success finally allowed me the opportunity to pursue my own interest—which is designing computer enhancements.

Now that you're on your own, so to speak, what major changes have you created at FBE?

Nothing major. We put in a SaveNet line for long-distance service. Our monthly sales used to be in the dozens. Now they're in the hundreds, and that means an added burden in providing technical support to those who need it.

I've always felt your manuals and supporting software were the model of clarity.

That's kind of you to say. But our customer base includes people with different levels of expertise, and those who are new to computers deserve a little extra handholding.

What do the letters FBE stand for? Is it a mysterious acronym?

Absolutely nothing. I just liked the sound of these letters. Now, I suppose, you might say they stand for Former Boeing Engineer.

Starting out

Did you start out working with computers or is this something you drifted into along the way?

When I was young, my big thrill was amateur radio. I became a licensed amateur radio operator in 1957, when I was 14. I qualified for a commercial Second Class Radiotelephone license in 1963, and received my First Class in 1965. I graduated from a "horse farm" (California State Polytechnic University) in 1965 with a BS in electronics engineering and a specialty in communications (like telephone, radio, microwaves, and so forth).

The school had a computer, off somewhere in a glass cave, to and from which students carried boxes of odd-shaped punched cards. Not me. Computers were junk. Radio communications was it.

What did you do after graduation?

Let's see—I took a job with Page Communications Engineers as a site engineer at an Army communications station on Midway Island. In 1967, I returned to the U.S. and spent a month or so travelling about western Canada in my "new" 1965 Porsche 356C. On the way home, I stopped in at Boeing, Seattle, and wound up spending the next 18 years there.

Since we're back at Boeing, do you mind discussing what kind of projects you worked on?

Not at all. I started out as a flunky engineer, as an "expert" in telemetry systems for use in testing airplanes. Later, I worked on data acquisition and tape-recording systems. From there, I migrated into analog electronics and then into digital logic.

Falling in love with elephants

Then I saw a computer. It was a Rolm 1602, and it wasn't in a glass cave and had no punched cards. It was just sitting there on a lab bench connected to a Teletype. And, through the Teletype, it talked! Amazing!

It was running BASIC, and I wrote a little program. Boing! Suddenly computers were great. Then I discovered DEC's PDP-8 minicomputer and took a company training course on assembly-language programming for the PDP-8.

I seem to recall that you mentioned in one of your letters that this started an extensive love affair with the PDP-8 minicomputer.

An obsession would be more like it. I discovered that Boeing's maintenance lab was using a PDP-8/L computer (with DECtapes) to test and validate equipment after maintenance. I spent a lot of time down there, learning what I could, and eventually took over the engineering responsibility for the system.

It was then that I decided that I had to have my own computer. I started reading the classified ads in *Electronic News* and got on several used-computer mailing lists. I joined the Amateur Computer Society and started receiving their newsletter. Stephen B. Gray was the founder of the ACS and the publisher. I've often wondered what happened to him.

There were folks in the ACS that had bought surplus mainframes and were running them in their basements! I began to get ideas.

I suppose that's how you got that elephant in the corner.

Yeah. I had been receiving flyers from Sonny Monosson's American Used Com-

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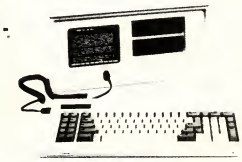

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puters for some months, and I always scanned the equipment lists. But, alas, the prices were always too high. (What a joke!) But, in February 1973, the price of a PDP-8/S dropped to $1,200. It was still pretty steep, but I bought one.

The DEC PDP-8/S contained 4,096 12-bit words of memory and a serial (bit-by-bit) processing unit. It was (and is) slow—about 26 microseconds to add two 12-bit words. I hooked it up to a terminal I had built out of a TV and a $50 ASCII keyboard, and a paper-tape reader. Remember those things?

Vaguely. I started with disks.

It was a fun period. But the real excitement came from the learning experience. It was a prelude to my eventually becoming a Heath/Zenith computer nut.

Starting FBE

Where, in this time period, did FBE materialize?

About 1975. A friend and I collaborated on an "outside" design job. He did the design and I bought the parts using the contacts that I had developed working on my PDP-8/S. (I was designing and building a lot in those days and needed parts.) FBE Research Company came into being for this project.

Then I wrote a cross assembler for the Intel 8080 that would run on my 8/S, and also a simulator. I could write 8080 programs and run 'em, too, and I didn't even have an 8080 computer. Nobody did. I put the cross assembler (CAL-80) and the simulator (SIM-80) on the market through a PDP-8 user's group newsletter. And FBE Research Company was really in business.

How did you get acquainted with the Heath computers? Looking around, I see a ton of old hardware I remember from the old magazines—Wameco, Tarbell.

Well, I was "desked" next to a chap, Al Feldman, a transplanted Austrian, who, in his spare time, worked as a technical translator. He was watching the computer boom booming away and was interested in word processing for his business. I asked around for a good, cheap computer and the word was Heath H89. So, in early 1980, he bought one. (I put it together.) Then I bought one, and another friend (Larry Malchodi) bought one.

Al also bought Heath's word processor, Autoscribe, one of the worst word processors ever written. (But of course we didn't know that at the time and thought it was nice.) I was using RUNOFF on my PDP-8/I.

Another PDP system?

I would hate to tell you how many of them I managed to acquire. I was consistently broke. I even had one of the early hard-disk systems (before floppies)—a DF32.

DEC made this monster. It had two platters, fixed heads, and could store a whopping (for 1969) 64K words total. That's laughable by today's standards.

Anyway, the three of us infected our co-workers with H89itus. By the time the disease peaked, about 15 folks had H89s and Boeing had nine, two with hard disks from Magnolia Microsystems.

Printers, device drivers, and the H89

During the early part of this expansion, I met George Klos. He had also purchased an H89, quite independent of us. We became good friends, and he became a real booster for the H89, converting many to the cause. He has since retired from Boeing and moved on to the 16-bit world (a Z100 and a Z160). But we're still good friends, and he's my favorite beta tester.

Towards the end of 1980, we all (George, Larry, and me) decided to get printers. We bought three Centronics 737's at a "discount" price of $900 each. (Wow!) They were good printers, but a bit flaky, with a nice proportional-print mode.

The 737 had a parallel interface which, of course, wouldn't plug into the '89. So, I designed an incredibly cheap and simple interface. I wrote a simple program to print files with it. We were all running HDOS at the time, so the next step was a driver.

Since there was no documentation on how to write drivers, I disassembled a couple (by hand) that came with the computer and figured out how they worked.

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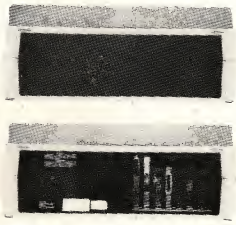

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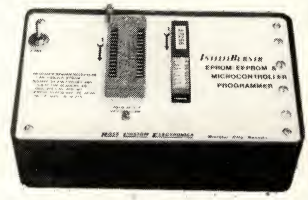

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Circle #160 on Reader Service Card

Then I wrote my own (CT.DVD), and FBE went into the printer-interface business.

I called the interface board the H89CTI, and would have been happy to sell six. But we wound up selling them by the hundreds. It was discontinued in 1983.

Didn't you also begin work on an 8" disk controller card around that time?

Yes, I did. My little group decided that an extra disk drive would be nice, especially an 8" drive because it offered more storage than the 5" 100K hard-sector Heath had introduced with the '89. I set about designing one.

The ground rule was, no modification to the '89 hardware or software. That was in July 1980. I had just got my disk controller working with my 8" drives under CP/M 1.4 when I discovered that Magnolia Microsystems had a super disk controller card in the works. I dropped mine (I hadn't learned yet that competition was possible) and moved on.

You must have been a little disappointed by your decision to cancel the disk controller.

Yes and no. Time whizzed by. I was selling so many interfaces and drivers that I had to give up my outside consulting work. And there was always a ton of work to do at Boeing.

Then one day a guy came over with an Epson MX-80 and asked me to help him get it operational on the '89, and we spent the afternoon getting it to communicate through the RS-232. You see, there wasn't any driver for it. The next week, I went out and bought one for myself. It made the old Centronics 737 look sick. Later that year I became an Epson dealer, and sold printers and interfaces and drivers as a package.

In 1982, we did the H89UTI Utility Card—which had two serial ports, a parallel port (special purpose, but OK for printer), a clock/calendar with battery backup, and a math-processor chip—and the H89RAM card, an alternative 16K memory expansion. (It piggy-backed over the top row of memory chips.)

There was also the ill-fated H8CTI card, which nobody bought.

The H8 was on its way out then, wasn't it?

More or less. It was overshadowed by the H89, a more sophisticated machine that lacked the H8's expansion capability.

If Heath had done to the '8 what Trionyx has accomplished over the last few years, it could have survived as one of the most versatile personal computers around.

Spooldisk 89

You know my thoughts about Spooldisk 89. Aside from Magnolia's hard disk controller cards, I think it's probably the most useful board ever designed for the '89. What led up to its design?

Early in 1983, having a pocketful of money from the H89UTI card, I decided to do something interesting. I thought about what I'd like, and came up with a combination electronic disk and printer spooler/interface card, the Spooldisk 89.

By then, I'd picked up a lawyer and an accountant. My lawyer suggested the name. The Spooldisk 89 was a little microcomputer on a card. It used an 8031 micro (a member of the Intel 8051 family), and had 128K of memory and a parallel/serial printer interface.

Unfortunately, about the time the Spooldisk 89 was ready for production, the supply of 8031 microprocessors dried up. It seems that the 8051 and its kin were the hottest microprocessors in history, and Intel couldn't keep up with the demand. Rats!

The Spooldisk 89 finally hit the streets in April of 1984 when my order of 8031's finally arrived. The Spooldisk 89 was intended to make a single-drive H89 into a practical machine to use as a word processor.

I bought an old H19, upgraded it the hard way (I built my own H17 disk controller on a piece of Vector board) to an '89, stuck a Spooldisk 89 and an H89UTI in it, and took it down to Boeing for my personal use. I had grown tired of having to schedule time on one of the two Z89s we had available for our use. Seemed like everybody in the office was using them.

As it turned out, I was the second person in our organization to bring his own personal computer to the office. The other guy had bought an Otrona (you remember them, don't you?) for $4,000. My weird '89 only cost me about $1,000. I wrote many a document for Boeing on that trusty old machine.

That was your last board for the '89, wasn't it?

And my most ambitious. A year after it came out, the price of 256K chips had dropped so low that I kicked myself for not designing additional circuitry into it so that I could substitute two banks of 256K chips for two banks of 64K chips, and drop in a new ROM to control the 8031.

Maybe you should have, but I haven't been constricted by the 128K memory. And I like the fact that I can use it to compose on, queue it for printing, and then reset the computer without interrupting the text flow to the printer. Is there anything else in the works for the '89?

I don't think there is much of a market for new '89 stuff. We still sell the Spooldisk 89 at a steady pace, but not at the same rate we used to sell it. Occasional '89 stuff like C.D.R.'s Super RAM 89 will do well, but the market is drying up. The computer is now almost seven years old—a very respectable age, considering the pace with which new developments in chip designs and manufacturing techniques are evolving.

The Z100

So, you're following the market by designing for the Z100 and for the Z150 series of IBM-compatibles.

We don't have much choice, do we? I think the Z100 is a superior machine to the Z150. But all the new software is being written for the Z150 and the IBM market. The Z100 is in an awkward position. It's sort of a transitional computer. It allows the owner of an H89 to transport most of his H89 CP/M software to the new system via the internal 8085 CPU. And they can use the faster, more sophisticated 16-bit 8088 CPU and MS-DOS.

What Heath and Zenith should have done was to make the Z100 totally IBM compatible. They would have been on the market with an IBM-compatible a year earlier. But that's hindsight. As it is, I don't believe they sold as many Z100s as they did '89s. And I think their IBM-compatibles sales are drowning the Z100.

And the Z100 isn't fully compatible with some of the specialized S-100 bus cards available on the market. Most of them could be made to work with it by either a firmware or software change, and the Z100 owners and potential owners could have access to plug-in boards that will out-perform a lot of stuff that's available for the IBM—multi-megabyte RAM disks, high-resolution graphics, co-processing cards. Heath/Zenith should have adapted a few of them in order to get the ball rolling.

But they didn't. I believe their marketing plans dictated the need to produce an IBM-compatible computer, and that tied up their engineering talent.

What about the new Gemini and UCI IBM-emulator boards?

They're nice. We had a rep from Gemini visit our local area HUG and give us a demonstration. I was really impressed. But look at the cost. For a few hundred dollars more you can buy a basic entry-level IBM-compatible from Zenith.

Well, if you're so hot on the Z100's potential, why don't you adapt some of those S-100 boards for this market?

Three years ago, I would have jumped at the chance, but we didn't have the financial resources to mount and advertise such a project. Now that we do, our current line of products—ZCLK and ZMF100 for the Z100 and the Mega-RAM-150 for the Z150 series—are selling so well that we are hard-pressed to keep up with orders.

As it is, we no longer assemble our own boards. Our volume requires that we farm out the basic manufacturing to an outside firm. We then test each board individually, pack them and ship them. The same applies to our software support disks.

I know that ZCLK—that little clock board for the Z100—has done very well. How is the ZMF100 board doing?

The ZMF100 surprised me. I designed

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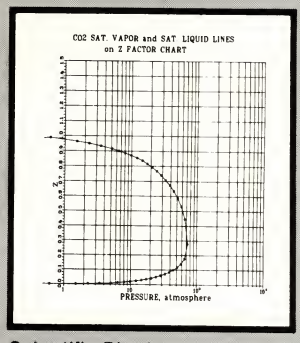

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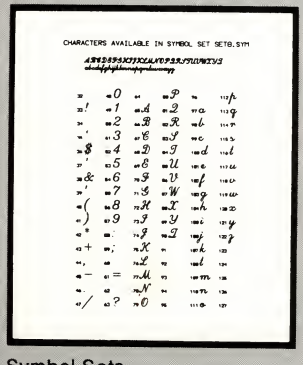

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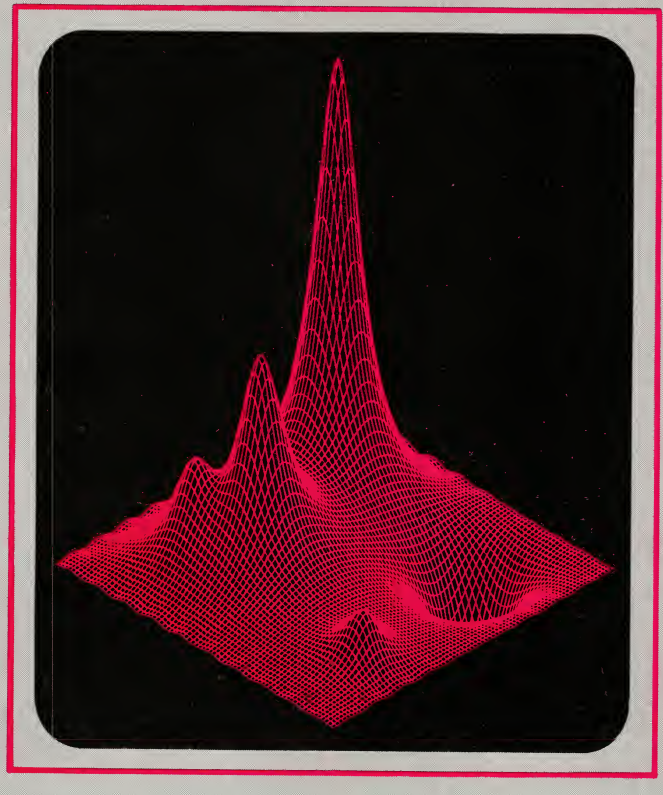

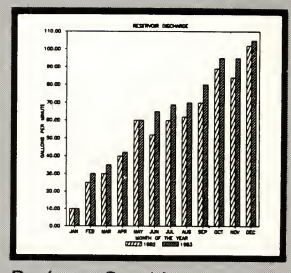

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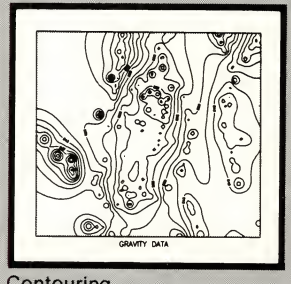

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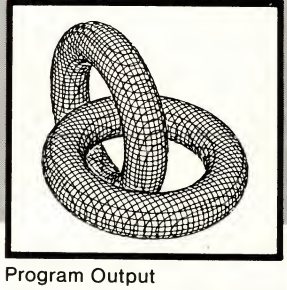

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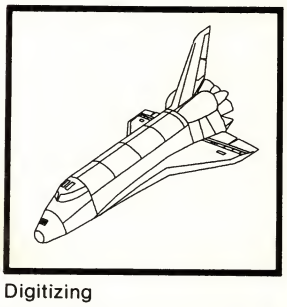

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it on a whim to allow my older Z100 to use 256K RAM chips so that the user could have up to 768K of available memory for larger programs like Lotus. It is a very cheap and simple modification that resulted in orders for more than 600 units even before we could schedule advertising for it.

What's next?

You seem to have developed a knack for practical enhancements.

I suppose so. But if you'll look back, most of our stuff had very practical applications. I try to put myself into the computer user's position by asking if this is something I can use, and will I get value for the dollars I'm spending?

There's a lot of repetitious stuff on the market—especially for the new machines—and most of it is very expensive. Somebody's got to pay for the color ads in *Byte*. I don't hold with hucksterism. I'd rather have the customer come to me out of a real rather than artificial need. Maybe that's not the right attitude?

Tell me, Dave. What are some of the new products you have in the planning stage?

That's not a very sporting question, is it? But I promise that you'll be the first to know.

****

A quick update

Changes in the computer industry follow what may be described as a preordained pattern of natural product evolution—or chaos. So, I should give you an update on the discussion of FBE's ZCLK board for the Z100. At the moment, it is still distributed exclusively by Heath/Zenith. But the Spring 1986 Heath catalogue shows it on "Last Call"—a Heathism for "There ain't no more when the stock runs out."

For the Heath/Zenith community, however, there will be no shortage of ZCLK boards; the distribution rights will revert back to FBE Research. (Let's hope that FBE will realign the price downward a bit.)

I would also like to mention that one of FBE's clock-board designs is going to be available for the Digital Equipment Corp. Rainbow computer. It has been licensed to an independent vendor, and the first year's production run is anticipated to be several thousand units; FBE has chosen not to manufacture the boards because of their involvement with several forthcoming products for Heath/Zenith computers. The vendor will handle the manufacturing at one of their factories in the Far East.

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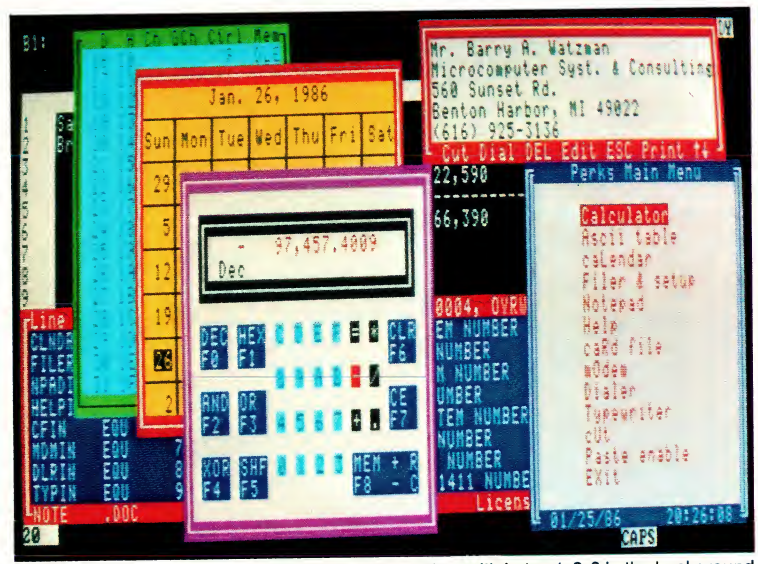

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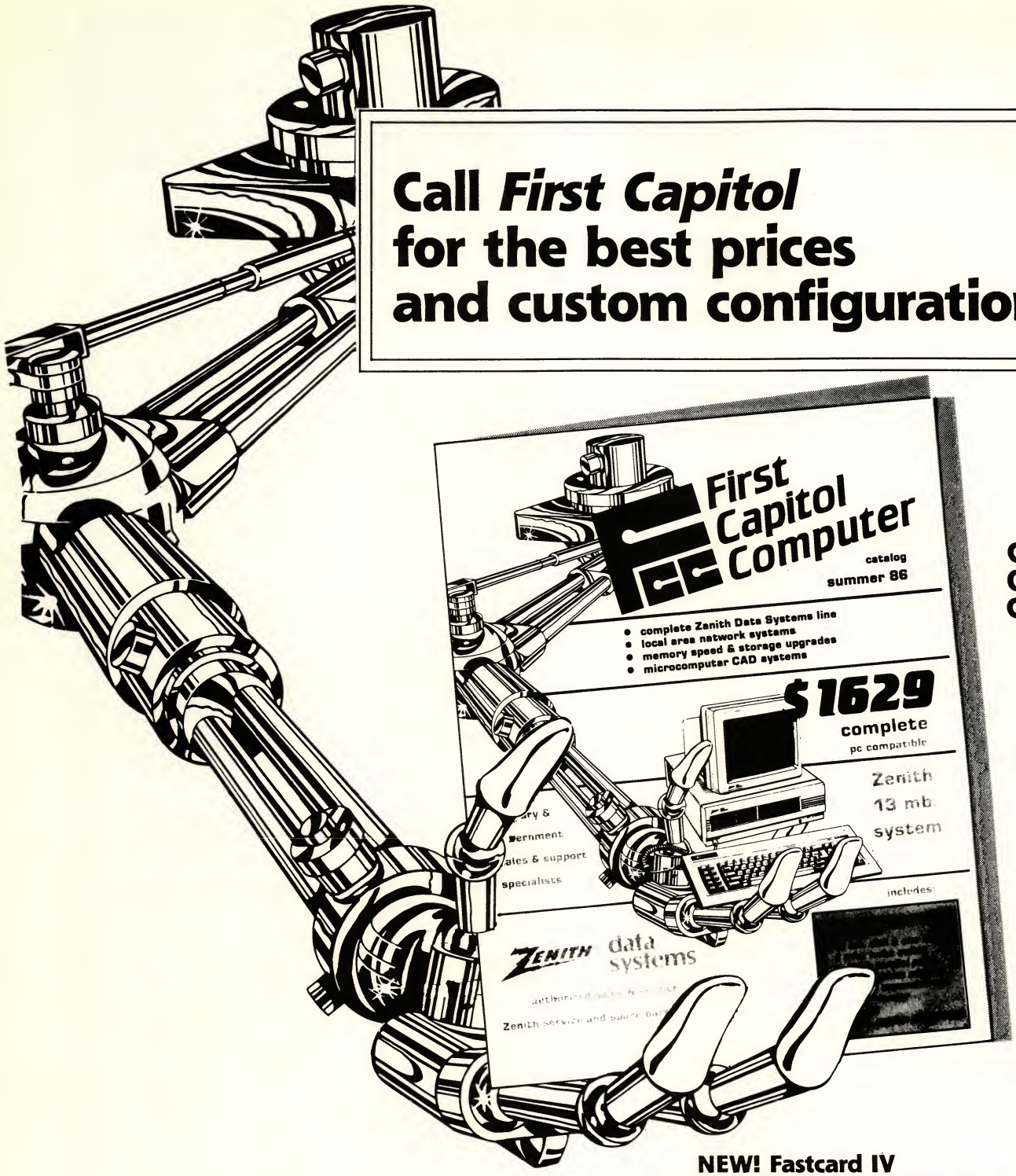

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Circle #206 on Reader Service Card

Microsoft Word, Version 2

Some Z150 purchasers got Word thrown in at no extra charge. Our first review suggested that's about what it was worth. Microsoft made some improvements, added some features, and offered an update for $50. So it's time for a second look.

Freddy Sweet

When I sit down at my Z150 and load practically any word processing program, I feel as if I am taking part in some modern miracle. This assemblage of cold-looking cream-colored boxes allows me to type and move text around almost effortlessly. That fact thrills me so much that I willingly accept bugs, glitches, and general weirdness in all kinds of word processing software.

That doesn't mean I don't scream at the machine and pound the keyboard when I am unable to make the software do what I want it to—particularly after long hours of trying to make the words come out right in my head. By and large, though, I am a very charitable, almost reverent user.

But I am also fickle; like many other writers, I am always looking for the perfect word processing program.

And what would be perfect? Something invisible. Something like a pane of glass on the surface of the subconscious mind. A window through which one has a clear unobstructed view of reality. In other words, a system in which nothing mechanical gets in the way of the creative process.

The word processing program I use most often is Microsoft Word, running under version 2 of the Microsoft Disk Operating System (MS-DOS). Although I love the way it works, I'm the first to admit that Word is not perfect. Because of some of the problems in version 1, I anxiously looked forward to the update. Now, after using version 2 for several months, I fear that I have mixed emotions: gratitude and disappointment and some distress.

I am grateful that Microsoft has been able to improve in so many ways a basically excellent program. I am disappointed that its major annoyance, the way it paginates documents, is not much improved. I am distressed that by adding many features, they have slowed down some of the operations to a snail's pace.

(Version 3 of Word was announced this April. Although this is strictly a review of Word version 2, my responses have remained essentially the same in my first work with version 3. For some particulars on version 3, see the comments accompanying this article.)

> ***I have mixed emotions: gratitude and disappointment and some distress.***

Several of the improvements Microsoft has made in version 2 make this piece of software approach the idealized state of invisibility; they make working in Word a pleasure:

1) There are now more lines available on the screen for text.
2) It is now possible to move into the operating system and into other programs while working in Word.
3) There is much clearer documentation, making it easy to find things in the manual—things which in many cases have been part of Word all along.

Then, once your document is finished, two more improvements make it even easier to produce very professional-looking documents:

1) There is an 80,000-word spelling checker/dictionary; and
2) The update provides much broader printer support.

The suggested retail price of version 2 is $375; for those of you with an earlier version, the update will cost $50.

Before going into details about version 2 in comparison with version 1, some background might be in order for those of you who may not be acquainted with Word. (You also might want to look at *Sextant* #14, January-February 1985, for David R. Felstul's review, "Microsoft Word and Mouse: Do They Click?".)

Word's way of doing things

Word processing programs are usually very similar when it comes to text entry; typing is typing, after all. The differences show up in such things as cursor control, movement through the entire document, and giving instructions to the word processor itself to do such things as a global search and replace. Many of you may have strong preferences for one or another way of handling things.

For global changes, for instance, some word processing programs employ a command mode; commands are typed in at a command line, much as you would give commands to the operating system. Similarly, print-formatting commands are included as separate lines of text in your document, usually started with a period, or "dot."

Other programs are almost exclusively menu driven; in some, you move the cursor to a choice or type a letter indicating it, then it asks you to type in the word you wish to find. Others go midway: a control key or Alt key is used to indicate you wish to search; you then type in the word to be found. And the special function keys may also be used for any number of purposes.

Cursor control might be either by the arrow keys or by the WordStar convention of CTRL-E, -S, -D, and -X—perhaps

Freddy Sweet holds a Ph.D. in comparative literature from the University of Michigan. He's also a graduate of the London Film School, and since 1977 has worked in the film and television industry as a writer, producer, director, cameraman, editor, etc.

even both. Some programs use a mouse.

Microsoft Word is designed to make use of practically all these methods. Only the command mode is absent. To do its job, Word uses combinations of mouse manipulations, function keys, and the control, Alt, and shift keys in conjunction with the numeric keypad.

At the base of this eclectic design philosophy is the desire to provide users with as much flexibility as possible so that they can adapt the software to their particular needs. Also, there seems to be the assumption that even if performed in some sterile office, word processing should be fun.

Some procedures in Word are very simple. It is easy to enter and delete text, and to highlight it for moving or copying. For the more common print-formatting commands—such as underlining, boldface, or italics—it is simply a matter of highlighting the desired words and then typing Alt-u, Alt-b, or Alt-i.

You can use both the mouse and the arrow keys for cursor control and selecting menu items. In most cases, using the mouse with menus involves clicking either the left or right mouse button while the mouse cursor is located in some marked-off part of the screen. To move large distances within the document, for instance, the mouse is clicked when its cursor is placed on a bar that is part of the frame of the display. Put it about three-quarters of the way down the bar, say, and you'll be taken to a point about three-quarters of the way through the file.

A mouse is not required; some users do not even have them. Nonetheless, use of the mouse makes many of the operations much easier. With the mouse highlighting text, for example, selecting items from menus is almost effortless.

It is only when very detailed work for formatting and printing is needed that Word requires the user to devote many hours learning how to uncover some of its vast hidden powers. Yet, after that hard work, Word really comes into its own.

If you are used to WordStar, you may not ever have used the arrow keys or the special-function keys. In that case, you may find Word a bit much in its demands on you to move your fingers all over the keyboard. And if you like Displaywrite with its hierarchical menus within menus, then you may find the freewheeling feel of Word somewhat disorienting. But if you want the richness that can be provided by using the entire keyboard and a mouse, then you will appreciate Word's design philosophy.

If you like seeing on the screen exactly what you'll get on the printer, then you'll absolutely love Word. And the process is easy.

For instance, in a few keystrokes I could call this paragraph onto the screen and make it so that it would later print out with, say, one and a half spaces between lines.

And there are no distracting print or formatting codes on the screen—as there are with WordStar and many other programs. Text to be printed centered and in boldface shows up centered and in boldface; you don't get just ordinary text preceded and followed by special codes.

Moreover, you will never have to exit the program in order to format or reformat the document for the way you want it to look when printed.

Copy-protection and system considerations

When I bought my Z150 in late 1984, it came with a free copy of Word version 1; that particular implementation was customized for the Zenith and came with its own special documentation. While not "generic" MS-DOS, version 2 of Word is intended to run on all computers compatible with the IBM Personal Computer. (It does not, however, run on the Z100.)

Version 1 could make do with 128K of memory; version 2 needs at least 192K. It needs a total of 256K in order to use the dictionary and gain access to the operating system and other programs from within Word.

Since acquiring the '150, I have souped it up simply so that it could run Word better. I started with 320 kilobytes of random-access memory (RAM); I added another 320K on a multifunction board so that I could work in a phantom drive C:—just so Word wouldn't have to refer so often to a physical disk as I worked.

I needed the speed of the RAM disk because Word does tend to be slow in some functions. There is nothing more frustrating to me than being able to outtype the software (at my usually plodding 60 words per minute)—and being forced to wait for the disk to chug before the letters I just typed are displayed on

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the screen. So I installed the additional memory and created a C: drive using RAM-disk software.

Both version 1 and version 2 of Word are copy-protected, so a copy of the program has to be in the A: drive. The Word manual tells you which of Word's files can be copied to the RAM drive. But occasionally some operations still require the program to go to the disk in A:. (This does not apply if you use Word version 3, because it is not copy-protected.)

Packaging

Version 2 of Word comes nicely packaged in a plastic fold-out box, which later doubles as a stand for documentation or for manuscripts. Also provided are an exquisite manual, a plastic keyboard template, a quick-reference guide, and five diskettes. These disks are: 1) the program, 2) a back-up copy of the program, 3) a utility disk, 4) a dictionary, and 5) a tutorial.

Some improvements over version 1

One of the best features of Word has been its windows, the ability to work with up to eight different files on the screen at the same time.

The main work area (or window) now allows for 22 lines of text, three more than in version 1. This is made possible simply by allowing the user to drop the main menu out of sight. (Until version 2, Word dedicated four additional lines to its main menu.) The menu reappears with the click of a mouse or with the hitting of the ESCape key.

Gaining these extra three lines of text means that the windows are larger and much easier to manage. Having the option of getting rid of three menu lines may not seem like much. For me it is a blessing, however, since I like to see as much of the page as possible.

In word processing, I prefer an uncluttered screen. WordStar and Volkswriter have always appealed to me because they leave so much of the screen open for writing and editing text. But Word requires working within a frame, literally a double line that encloses the entire work area.

This frame was not designed as a pretty ornament; as indicated above, it responds to the mouse, allowing for scrolling and division into windows, among other things. This frame uses up two of the lines on the screen. Now I wish Word would give me the option of eliminating the frame when I am not using the mouse.

I am even considering investing in a high-resolution graphics card so I could be able to see 43 lines (instead of 25) displayed on the screen.

Ability to run other programs

In version 1 of Word, a mysterious category was included in the main menu. It was the "Library." Selecting it produced the message that it was reserved for future use. Now the future is here.

Library, as a menu option, is available, and it is a passageway to other programs while only temporarily suspending word processing. It allows for access to the dictionary, an automatic hyphenation program, and the operating system, as well as other programs, such as BASIC. I use it all the time to copy documents from B: to the RAM disk.

The ability to run the operating system is particularly important when working with large files. I often tend to forget about my disk capacity, and find myself with a message saying "document disk full". Now that I can run MS-DOS, I can exit the program and erase a backup file or two, save the file that I am working on, and escape from a possible problem.

There is one limitation to this new feature, however. As far as I have been able to figure out, it is possible to do only one operating-system operation before being forced back into Word. So, in order to view a directory of disk B: and erase two backup files, it is necessary to exit and re-enter Word three times.

Now that is annoying. I would like to be able to stay in MS-DOS for as long as I need to and then re-enter Word at my leisure. This may be something that is possible, but I have not yet figured out how to accomplish it.

The dictionary

Version 2 comes with a very useful 80,000-word dictionary. For a writer, it is like having a proofreader at your side. You can call up the dictionary at any time you wish; it will check your document for misspellings and typos in words longer than two letters.

Unlike some dictionaries on the market, this one does not run as you type. So it cannot flag misspelled words as you

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type them in. But once the dictionary is called up through the Gallery menu, it saves the entire document and runs it through the spelling checker at that time. It will run the entire document through three different word lists and make corrections at the tap of a key.

The spelling checker is one of the real strong points of the update. A good dictionary for your word processor could cost you almost as much as the $50 price tag for the update. If for no other reason than the dictionary, I would recommend that version 1 owners upgrade to version 2.

Printer support

When it comes to printing, Word is in its element. It is designed to drive practically every printer on the market now and in the immediate future. It works better with laser printers than any other program, since it takes advantage of the variety of fonts and formats laser printers have to offer.

For those of us without laser printers, however, version 2 of Word has still made our lives a lot easier. The utility disk now includes a list of over 50 printers, including my Brother HR15, a printer not supported by the earlier version.

Previously, I was forced to run the Brother using a Diablo configuration, and the results were far from spectacular. I was never able to get the proportional-spacing daisywheel to underline text in the right place. But now the proportional-spacing wheel is supported for my model of printer. By setting up a style sheet and coding each of the different daisywheels I use, I can produce excellent copy almost with ease.

Once the program is configured for a particular printer (and a specific font within that printer) everything is then automatic. For instance, in order to use a daisywheel with proportional spacing on my Brother printer, I select that particular font and a suitable style sheet. Then that typeface gives me everything I need, even underlining that is proportionally spaced and doesn't extend beyond the words I have selected.

Not all word processors are as generous as Word in the number of printers they support. Some of you, then, may be used to accessing printer-hardware features by embedding the appropriate ESCape or control characters in your text file. Unfortunately, I do not know of any way to do so in Word.

However, I don't think that too many of you will find yourselves overlooked in the list of supported printers. Even if you are, though, there may still be hope. According to a review of Word in *PC World*, the Microsoft Special Interest Group on CompuServe has a menu-driven program to automatically create an MS-DOS device driver to interface Word to any printer. (See Burton L. Albertson's "And the Word is Good," *PC World*, September 1985, p. 182.) The program is called WORDPR.BAS; I have no experience with it, so I cannot comment, but drivers produced by it reportedly support all print enhancements except proportional spacing.

Style sheets

Style sheets are some of the jewels of Word. They allow the user to design pages that look typeset by assigning different fonts, formats, and layouts to different parts of the text on the same page. Style sheets are extremely useful when typing memos, outlines, business forms, and letters, and they ensure that all memos will have a uniform look to them.

A style sheet is a pre-structured format that can be applied to any document. Word comes with several style sheets on disk for outlines, memos, and business letters. In the manual and on the tutorial disk there are clear instructions for learning how to create personalized style sheets.

Let's say in my business letters I often want paragraphs that are double spaced, with all the text in bold. I can create a style sheet to do this. I would then name that style sheet, perhaps LETTER.STY, and then indicate the particular formatting instructions with a one or two letter code, perhaps "bd" for bold-double.

Once the style sheet is created, it is a simple matter of typing the Alt key and the key code—in this case "bd"—to apply its particular characteristic to the paragraph. The menus make it easy to create style sheets, store them, and attach them to particular documents.

Style sheets can be used for attaching formatting characteristics to characters, paragraphs, or entire documents. I use style sheets all the time for the very specific format requirements of motion picture screenplays. I have coded "n" to set up for character names and "d" for dialogue. By typing Alt-n, my cursor jumps to the middle of the screen where I can type in a character's name. With Alt-d, I am ready with new margins to start typing what my character says.

I make it even more convenient for myself by using the Glossary that is part of the Word program. This is a keyboard macro facility; that is, I can pre-set text to be input into the document whenever I direct. I code each of my characters with a particular letter and include the specific style sheet attribute along with that letter. Then when I want a character to speak, I just hit F3 and that character's letter code. With those two keystrokes, I can make a given name appear exactly where I want it in the middle of the page and reset new margins so I can enter the dialogue. With another two keystrokes, I can change character name again and be

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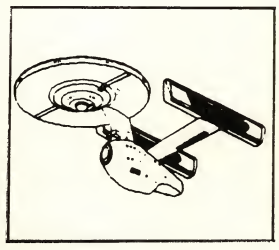

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ready to type in the dialogue.

One thing the manual doesn't tell you is that style sheets are the grease that makes everything in the system flow more smoothly, especially on a laser printer. When Word saves a document, it doesn't automatically save all of the formatting instructions I wish to give the printer. If there is no style sheet attached to a document and I need to reprint the document at some later date, I have to reset much of the formatting information. Without a style sheet, for example, Word doesn't keep track of how I want my pages to be numbered. But if I have defined a style sheet with all of this information, it is a simple matter of applying the style sheet to the document I want to print. Then Word honors even my most detailed instructions.

I find I use style sheets all the time—just to make sure that options such as bold, underlining, superscript, subscript and italics always come out just right on the printer.

The tutorial

One of the diskettes contains a tutorial program that is a model of interactive learning; it is ideal for the beginner.

The tutorial is particularly useful since Word seems rather forbidding to the uninitiated, with all of its strange terminology, such as "Glossary," "Gallery," or "Library." One doesn't simply save a file, one Transfers, then Saves it. One doesn't simply delete text, one deletes to "Scrap," from which one can insert back into the text. By providing a tutorial with version 2 of Word, Microsoft has made the program much more accessible.

The tutorial program is also useful for those of us who have been using the program for a while. It makes it much easier to learn some of the advanced features, such as merging, running headings, footnotes, style sheets, and Glossaries.

The tutorial program does not include instructions on the use of the mouse, but the mouse commands are, for the most part, easier than using the menus. The use of the mouse is easy to learn, especially with the plastic keyboard template supplied with the package.

The template

The keyboard template is very handy, and fits over the standard IBM keyboard as well as the keyboard supplied with my Z150. It is a two-sided affair. On one side it lists uses for the special-function keys and the cursor keys, character formatting (such as underlining and italics), paragraph formatting (such as centering and changing margins), and commands to move text around in the document.

On the other side of the plastic template are short descriptions of over thirty mouse activities.

I find this template very useful and a definite improvement over the little paper foldout that came with version 1 of Word.

Documentation

The earlier manual was disorganized and not very well indexed; it took a great deal of time to figure out how to use the program. Now an improved, beautifully designed and superbly printed manual reveals all of the program's little hidden treasures. The text is very clear and is filled with many handy examples and helpful hints.

The problem of pagination

Unlike other word processing programs I have used, Word does not paginate as it goes along. The ruler or status lines at the top and side of the screen do not indicate what page you are on or what line you are on on the page.

New Features of Version 3

Version 3 of Microsoft Word claims nine new features:

- Headings in an outline can be linked to the text of a document. Changing the order of the headings will move the appropriate paragraphs of text around.
- Index entries in a document can be used by Word to generate an index. Headings can be gathered into a table of contents. Word can also list all inclusions, such as photos or figures.
- Various operations can be performed on individual columns of text in a table.
- Lines or paragraphs of text can be sorted.
- Mathematical operations can be performed on numbers within the text.
- Columns of paragraphs can be created, with corresponding paragraphs side-by-side even if they differ in length.
- Documents can include sections of text that can be suppressed or displayed on command.
- Appropriate sections of the Word tutorial can be invoked from within Word.
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To divide a document into pages, the user must submit to a very tedious procedure. It is necessary to hit the ESCape key, select "print," then "repaginate." Two options are then presented: 1) let Word paginate the document automatically; or 2) confirm each page division Word makes.

In version 1, you had to take what Word gave you. If you didn't like what you got, you would have to go back into the document and add a carriage return here and there in the hope that the pages would come out the way you wanted them in the first place.

So, the option of confirming Word's choices is an improvement over version 1, in which pagination was total guesswork. But the repagination process is very time consuming and cumbersome.

Heaven help you if you accidentally confirm a page break and want to backtrack to correct it. Not possible. It will be necessary to start over once again from the first page of the document. On very long documents, this procedure is most annoying.

There is one incomprehensible feature tied to the repagination problem: just to print one page somewhere in the document, the document has to be entirely repaginated up to the selected page. When it reaches the page you want to print, it stops repaginating and begins to print that page.

In other words, when you choose to print a particular page, let's say page 25 of a 30-page document, Word tells you it is repaginating each of the pages up to 25. That is true even if it just repaginated a few minutes earlier and no changes have been made to the document. This process, of course, seems to take forever.

Then, after the document has been repaginated, Word still doesn't tell you what line you are on on a page. For me, knowing where I am on the page is extremely important—especially when laying out tables or title pages, or preparing text for brochures with illustrations, where an accurate line count is essential.

In the past year, I have spoken to several writers and screenwriters who, after using Word for a while, gave up and went back to WordStar. The reason was always the same—pagination, or lack of it. I hope Microsoft provides future updates with an option for pagination and line counts while text is being entered in the document.

There may be a purpose behind Word's pagination. Kenneth W. Daniel covered Word in "The Quest for the Ultimate Word Processor." (See *Sextant* #18, September-October 1985.) He pointed out that Word is intended to serve as a typesetting word processor driving a laser printer—which requires it to be very sophisticated in keeping track of line and character spacing. Daniel suggested that, "Apparently, this extra sophistication is what drives Word to manual repagination."

A new problem

Because Microsoft has added new features, and has generally made Word a larger program, some of Word's operations are much slower in version 2 than they were in version 1. For example, to save a document takes more than twice as long with the upgraded version. My original file for this article (about 14K) takes about 20 seconds to save in version 1.10, but it takes about 50 seconds to do the same task in version 2.

I've worked with documents as large as 130,000 bytes and waited a good five minutes for the document to be saved. If you have a long document, say 25 or 30 pages, then plan on taking a break after you have told the program to save the file, or else you will be sitting in frustration at your desk.

The documentation recommends saving the file every 15 minutes, but I don't know too many people who can sacrifice five to ten minutes an hour watching a very slowly chugging disk drive while waiting for a document to return to the screen. So I find I save files less frequently than I should, even though I know I am courting disaster.

Overall recommendation

Despite the problems of pagination and the slower speed of some functions, I would still highly recommend this upgrade to all previous users of Word. The dictionary and beautiful manual alone are worth the $50 price of the upgrade.

And I would continue to recommend Word to people looking for a word processor for the first time. But I would caution new users that they must be willing to invest a number of hours learning a strange lexicon, and that they must be prepared for frustration in dealing with the pagination problem.

I highly recommend Word for anyone interested in getting the best possible results in print. Microsoft Word is the word processing program that works best with a wide variety of printers, including laser printers. It is on the printed page that Microsoft Word approaches that dreamed-of state of perfection.

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Word version 2 (IBM compatibles only), $375; update for registered owners of version 1, $50. Word version 3, $450; update for registered owners of version 1 or 2, $75.
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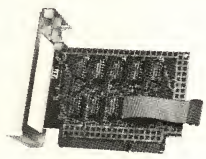

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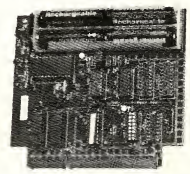

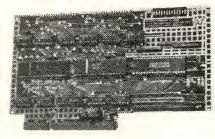

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Adapt Your Soft-Sector Controller to Use Hard-Sectored Disks

With some changes to the CP/M software, and an addition to the H37 hardware, it's possible to reuse those old disks you bought for the H17.

Ray Albrektson

Some time back, I had a chance to pick up a used H37 soft-sectored disk controller—at last I was going double-density on my H89! I ordered a couple of double-sided half-height drives and soon was up and running with a fabulous 320 kilobytes per disk.

It was a mixed blessing, I realized, as I opened a box of horrendously expensive double-sided soft-sectored disks.

I opened the drawer that contained several hundred dollars' worth of now obsolete hard-sectored disks and gazed at them ruefully. And I wondered for the umpteenth time if there wasn't *some* way to use them in my (now) soft-sectored system. Some of them were, I knew, of very high quality—a few were rated double-sided and double-density.

I knew of others in the same boat. Some used their old hard-sectored disks with their H17 controllers just to transfer software from the older to the newer, higher-capacity format, or to swap software with other '89 owners who have only the H/Z17 format. Others used theirs for keeping backup copies of important files. Most, however, sold off their hard-sectored disks at giveaway prices; or they left them (as I did) to molder away in the bottom drawer.

Weeks passed, and I decided to stop wishing and start building. After a few days of trial-and-error circuit design, I finally came up with a nifty adapter that allows the H37 disk controller to use any kind of disk.

I call it the Hard-Soft Adapter, or HSA for short. Whatever you put in the drives connected to the HSA, whether ten-sector hard-sectored or single-hole soft-sectored, the controller will always "see" a single-hole soft-sectored disk.

Although I use CP/M exclusively, this adapter should work equally well with the Heath Disk Operating System (HDOS); but some device driver modifications may be required—similar to the modifications described later for CP/M's basic input/output system (BIOS). H8 owners should easily be able to adapt the mounting and installation instructions to their computers as well—the BIOS changes are identical.

Ray Albrektson lives in San Bernardino, California, where he is a faculty member of the International School of Theology.

Grab the eleventh hole

How can this be? you ask. Study Figure 1, which shows the hole pattern of a ten-sector hard-sectored disk compared with a soft-sectored disk. Notice that the ten-sector disk has eleven holes. (Some people call it a ten-hole disk anyway.)

The eleventh hole (called the index hole) is sandwiched between two of the ten sector holes which are uniformly spaced around the disk. If a gadget could be made that would cause the disk drive to ignore the ten symmetrical holes and only "see" the eleventh, we would be in business.

A pair of devices, one called a one-shot multivibrator and the other a NOR gate, when combined, can perform that amazing feat. Figure 2 shows such a circuit, here dubbed the eleventh-hole grabber.

The input to the grabber comes from the disk drive itself. Specifically, it comes from the signal line that indicates when an index hole is lined up with the index-hole sensor inside the drive. This signal line is usually at +5 volts; but the alignment of an index hole with the sensor causes it to drop to nearly zero.

When the drive is running with a disk inserted, the output of that signal line consists of a series of low-going pulses created whenever a disk hole whizzes by the sensor. The trailing (positive-going) edge of this negative pulse causes the one-shot (U1) to trigger; and the resistor/capacitor combination causes U1's output (pin one, which is normally high) to go low for a short period of time.

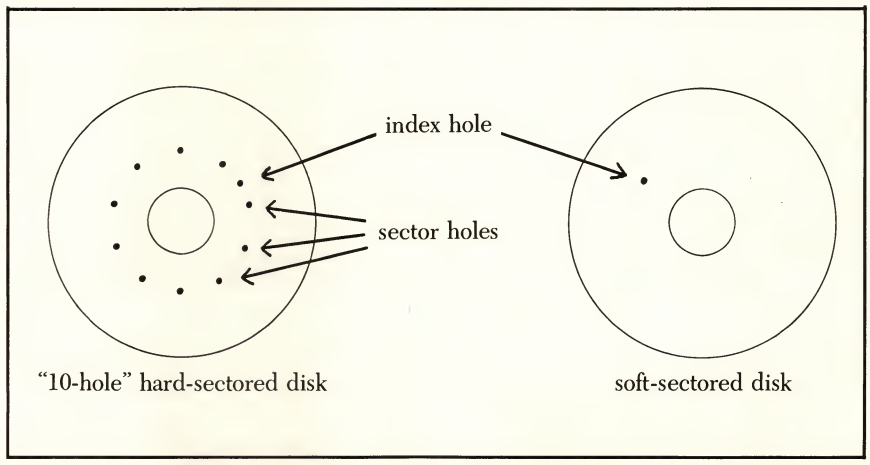
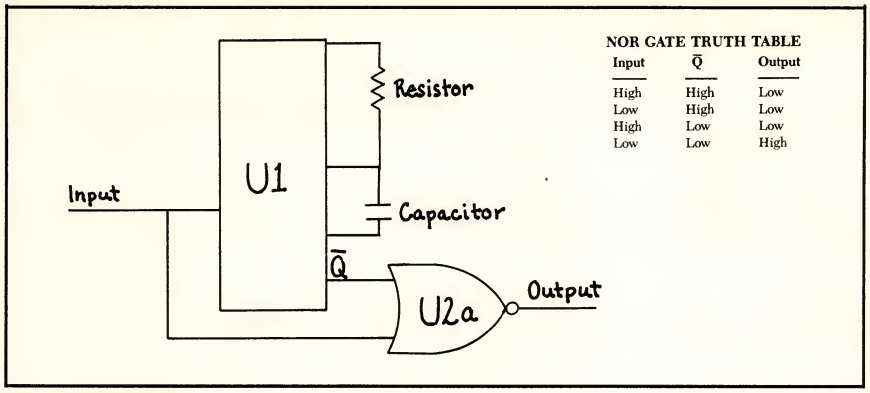


Figure 1. The hole pattern of a hard-sectored disk compared to that of a soft-sectored disk.



NOR GATE TRUTH TABLE

Input	Q̄	Output
High	High	Low
Low	High	Low
High	Low	Low
Low	Low	High

Figure 2. The eleventh-hole grabber circuit consists of a one-shot multivibrator and a NOR gate. The truth table of the NOR gate is also shown.

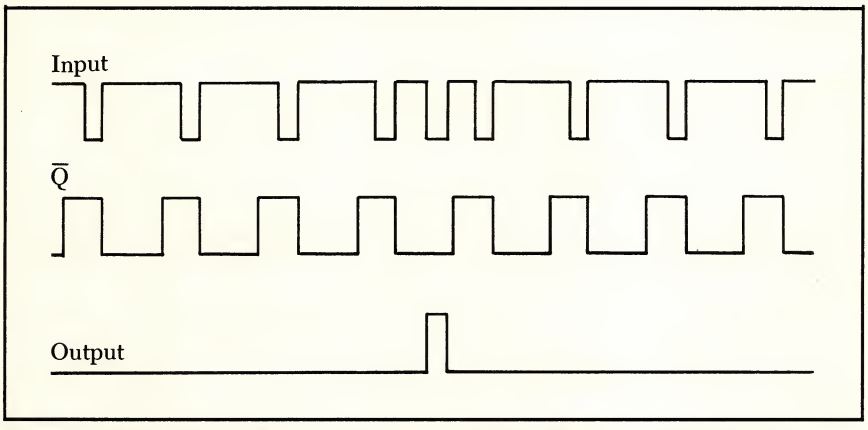


Figure 3. Timing diagram of the eleventh-hole grabber. The output of the NOR gate is high only when the input and Q̄ lines are low—which happens only when the eleventh-hole is sensed.

Note this: Once a one-shot has been triggered, additional pulses won't affect it until it has recovered. Only then is it free to be triggered into a low output again.

U2a NORs the output of this one-shot with the original pulse. NOR gates are simple but useful critters with only one thought in their bit-sized brains: they will keep their output in a *low* state until *both* inputs are low. Then, and only then, will a NOR-gate output go high. Remember that: Only having all low inputs yields a high output with NOR gates.

Here's how

Imagine that the grabber is in place and you have just attempted to boot with a hard-sectored disk in the '89's drive. The disk drive will probably start up with the hole-sensor somewhere between two holes. At this point, the hole-sensor's input to U2a (the NOR gate) is high, and the output of U1 is also high; thus, the NOR gate output is low.

The leading edge of a negative pulse arriving from the hole-sensor will cause one input of U2a to go low—but to no avail, since the output from the one-shot (U1) is still high (untriggered). The only event that will cause the NOR gate's output to switch high is if a stray negative-going pulse comes along while the one-shot is still in a triggered (low) condition. The basic process is diagrammed in Figure 3.

It so happens that the only time this

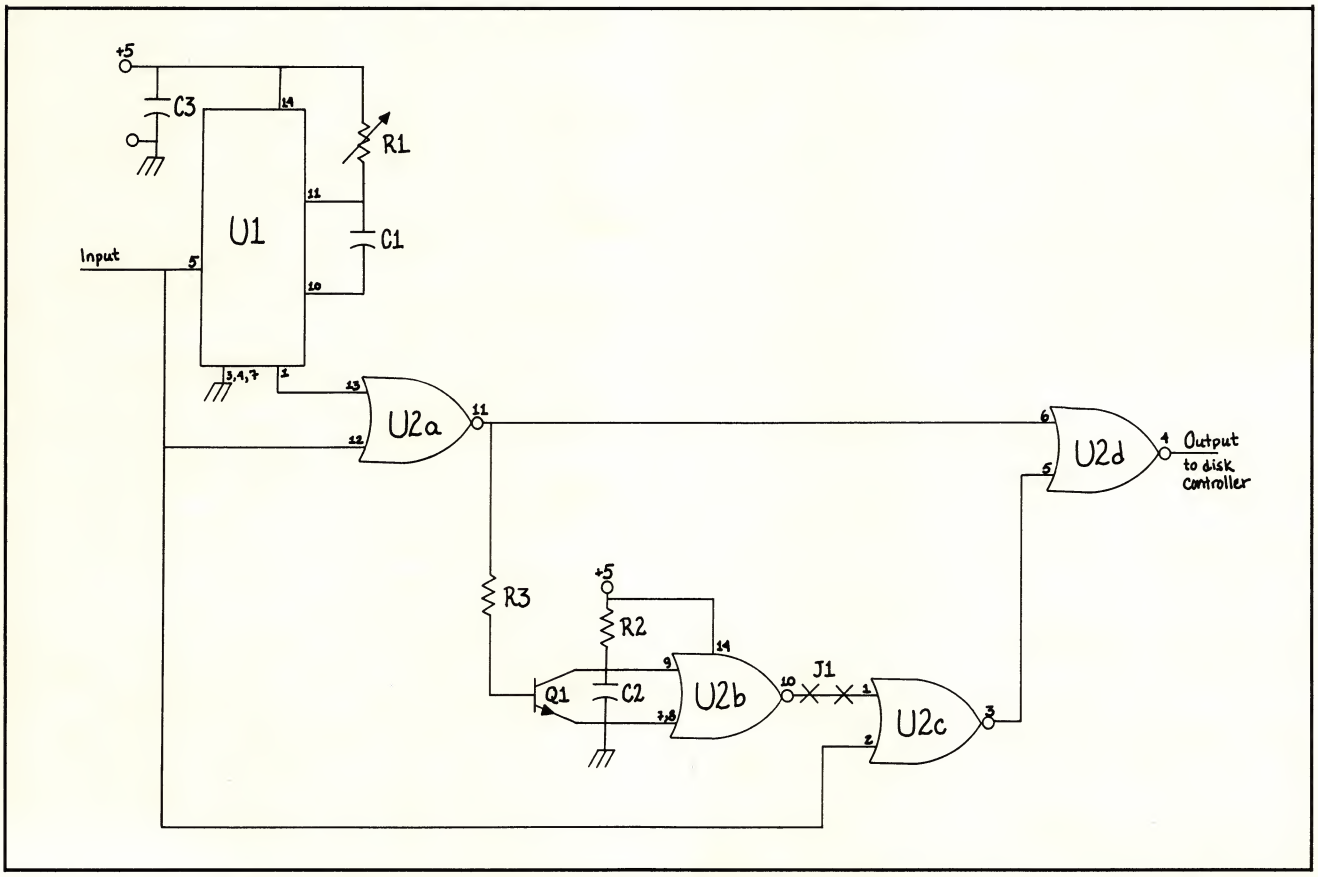


Figure 4. The Hard-Soft Adapter (HSA) circuit diagram. It incorporates the eleventh-hole grabber shown in Figure 2. See Table 1 for a parts list for the HSA.

occurs is when the eleventh hole comes along. The output of U2a, therefore, delivers positive pulses only on the eleventh hole!

Note that for U1 and U2a to work correctly, the resistor and capacitor combination that controls U1's pulse width must be chosen pretty carefully. We want the pulse width at the output of U1 to be shorter than the spacing between symmetrical pulses, but longer than half that spacing, so as to be sure to snare the elusive eleventh hole.

Using both formats

If you never wanted to use soft-sectored disks with your soft-sector controller, you could almost stop here. Just add another inverter to the circuit to get negative pulses back. Then wire it in and happily fool your H89 (or H8, or H100, or whatever) into thinking it was getting good old soft-sectored disks.

Unfortunately, if you were to try to use a soft-sectored disk with this arrangement, no pulses at all would come through U1-U2a. Your H89 would act as though there weren't a disk in place at all.

In order to make a more practical device, we need to include circuitry that will detect what kind of disk is in use. Our circuit should automatically control the device to leave things "as is" when using soft-sectored disks; but it should switch in the eleventh-hole grabber when using hard-sectored disks. The complete design of the Hard-Soft Adapter (HSA) in Figure 4 shows everything required to accomplish that mission.

Although it looks a lot more complicated, the three additional NOR gates used are already available for free—since two-input NOR gates come in packages of four. The additional components are a couple of resistors, a transistor, and a capacitor. (See Table 1 for a parts list.)

Step by step—hard-sectored . . .

Let's study the operation of the HSA in Figure 4 to see what happens with a hard-sectored disk in place.

The eleventh-hole grabber begins to work as it should—and eleventh-hole (index) pulses emerge from U2a. These pulses keep turning transistor Q1 on, which prevents C2 from charging (through R1) as much as it would like. Whenever Q1 conducts as a result of a pulse from the grabber, it drains C2 and keeps it from ever getting a decent charge.

The input of U2b (connected to capacitor C2) also stays in a low condition. Since the other input is grounded, U2b feels constrained to keep its output high, which it does. This high output is an input to U2c, which obeys the time-honored code of NOR gates and keeps its own output low no matter what its other input is doing.

The output from U2c serves as an input to U2d. Since this input is low, and the other input has the positive pulse from the eleventh-hole grabber, the output consists of just the right negative pulse needed to drive the disk-controller.

. . . and soft

Now consider what happens when a single-hole (soft-sectored) disk is inserted in the drive.

Now the eleventh-hole grabber produces a uniformly low output since there are no eleventh holes to be grabbed. This means that Q1 never fires, and the charge on C2 is allowed to build up. This causes U2b's output (U2c's input) to go low. U2c's other input consists of the original negative pulses—and the resulting output is positive pulses.

The last NOR gate, U2d, has those positive pulses on one input; the continuously low signal from the eleventh-hole grabber is its other input; so, the output is a close facsimile of the original negative pulses. They are delayed a few nanoseconds by their trip through two NOR gates; but that won't matter to the disk controller.

We can see that the circuit in Figure 4 does everything that we want it to do. When a hard-sectored disk is inserted it sends through only the eleventh-hole

Parts List for Hard-Soft Adapter

U1	74LS121 One-shot multivibrator
U2	4001 Quad 2-input NOR gate (Radio Shack 276-2401)
Q1	2N4401 NPN transistor (R/S 276-2058)
R1	50-kilohm trimmer potentiometer (R/S 271-219)
R2	470-kilohm ¼-watt resistor (R/S 271-1354)
R3	22-kilohm ¼-watt resistor (R/S 271-1339)
C1	2.2-microfarad (10-volt minimum working voltage), PC-mount type
C2	4.7-microfarad (10-volt minimum working voltage), PC-mount type (R/S 272-1024)
C3	47-microfarad (10-volt minimum working voltage), PC-mount type (R/S 272-1027)
J1	Jumper wire made from clipped end of capacitor lead
Misc:	Two 14-pin IC sockets; bits of hook-up wire; fresh solder

Table 1. Parts list for the Hard-Soft Adapter (Figure 4).

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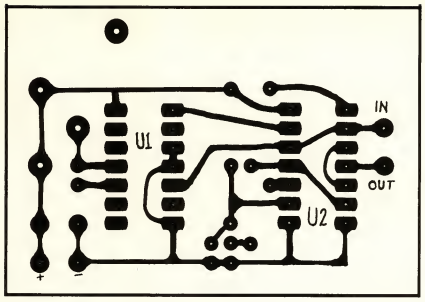

Figure 5. Foil-side view of the printed circuit board for the Hard-Soft Adapter. (Shown full size.)

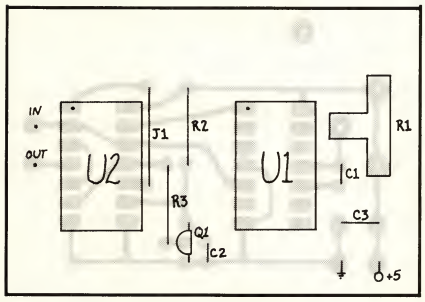

Figure 6. Component-side view of the printed circuit board layout for the Hard-Soft Adapter. (Shown full size.)

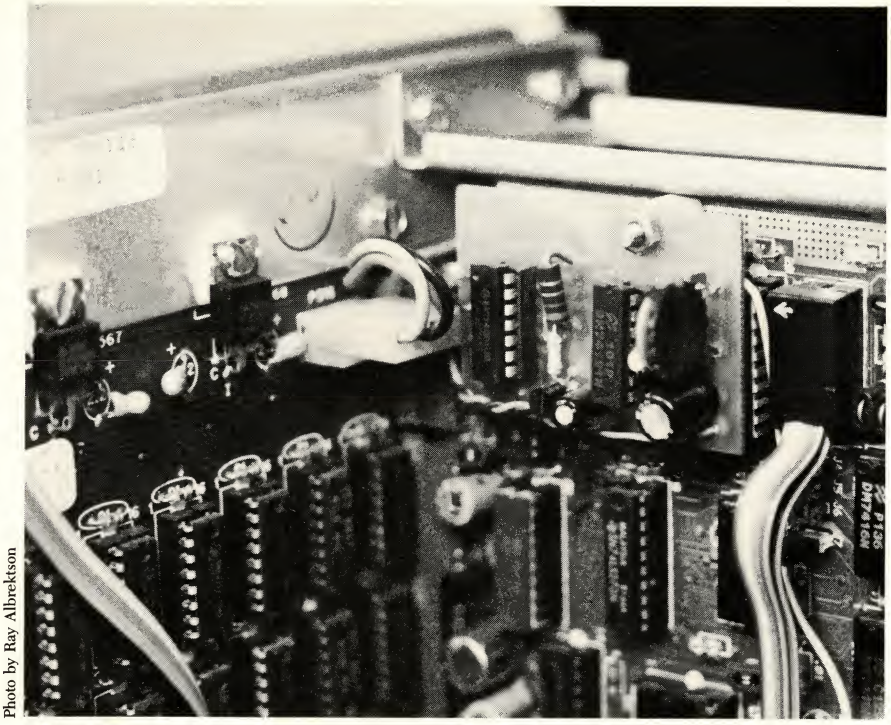

Photo by Ray Albrektson

Photo 1. Hard-Soft Adapter board mounted on the top inside corner of the H37 controller board.

pulses. When a soft-sectored disk is in place the index pulses are passed through without alteration.

Our next task is to build one and hook it in place.

Building it

Even for a simple two-chip project like this one, I feel you can't beat a nice printed-circuit (PC) board. A foil-side view of one I laid out is shown in Figure 5; Figure 6 is the component side. I've developed some tricks that enable me to make a PC board this size in under an hour. And the improved reliability (not to mention looks) really makes it worthwhile.

Building the board isn't especially difficult, even if you don't use a PC board. I suggest the same general layout as figures 5 and 6. It works, and the size allows it to be mounted snugly up on the top inside corner of the H37 controller board. (See Photo 1.)

When handling U2, the 4001 NOR gate, be careful to avoid conditions of high static electricity. Although U2 is internally protected against static damage, it is just as well to err on the cautious side with CMOS devices.

Test and finish the job

After completing construction, but before inserting U1 and U2, perform resistance checks. The input and output should show infinite resistance to everything but their respective IC sockets. The input line should show zero to pin 5 of U1 and pins 12 and 2 of U2. It should show infinite resistance to everything else.

Similarly, the output line should show infinite resistance to everything but pin 4 of U2. The 5-volt supply line should show zero to pins 14 of U1 and U2 and one end of R1 and R2. The ground line should show zero resistance to pins 7, 3 and 4 of U1 and pins 7 and 8 of U2.

While the ohmmeter is at hand, set the variable resistor (R1) to a resistance of about 12 kilohms—this will probably be very close to the optimum operating point to be confirmed experimentally later.

After the resistance checks are completed, apply +5 volts to the HSA; but do not hook up the inputs and outputs. I use a 6-volt lantern battery for these smoke tests. It is my earnest hope the slightly higher voltage will cause marginal components to fail. If you have a milliameter, check the current flowing into the adapter—it should be about 20 ma. If it is significantly higher (30 ma or more), look for wrong component values or defective chips.

Assuming everything tests out OK, remove the soft-sector controller board and prepare to install the HSA. I used a ⅜" spacer cut from the shell of an old ball-

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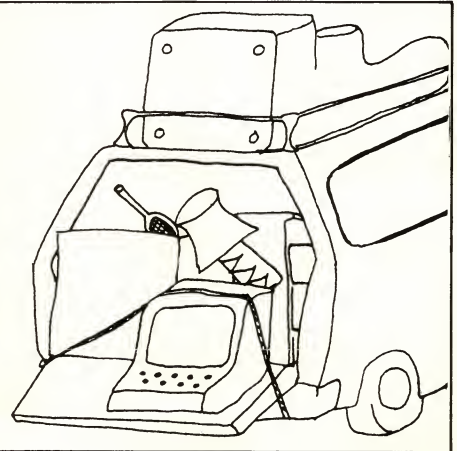

point pen and a suitable nut and bolt to hold the board onto the soft-sector controller. A handy hole at the top edge of the H37 controller was already provided, so there is no need to do any scary drilling. (See Photo 1.)

I routed the +5 volt and ground wires (twisted together) around the back of the controller and soldered the ground wire to the back of pin 2 of the large 25-pin bus connector, and the +5 volt wire to pin 1 of the same connector. (See Photo 2.)

Now remove U13 from the H37 controller board. Carefully bend out U13's pin 7 so that it is sticking out horizontally. (See Photo 3.) This IC combines signals from the drives connected to both drive-cable connectors; it allows us to use just one HSA for both internal and external soft-sectored drives.

To pin 7, solder the adapter's input wire; and solder the adapter's output wire to the corresponding socket location on the back of the H37 card.

There's an alternative if you just can't bring yourself to solder directly to the H37 controller board. (And I can sympathize!) Remove U13 and bend pin 7 out as before. Insert it in a 16-pin IC socket. Insert the HSA output wire into the empty spot in the IC socket; then seat the piggybacked pair into the socket where U13 goes. Then simply solder the adapter input to pin 7 of U13.

This works better with some kinds of IC sockets than others—try to find one with strong round pins rather than flat ones.

Set R1

Reinstall the H37 controller board, apply power, and boot up. If you're lucky, you will be able to boot with no trouble. If nothing happens or you get "BDOS Error on A: SELECT," then retry booting with R1 set slightly to either side of the 12K setting you measured earlier.

To optimize the R1 setting, you should get a program to measure the accuracy of the disk rotation speed. I use the public domain ROTATE.COM program. Run ROTATE.COM (or an equivalent program) with a soft-sectored disk in

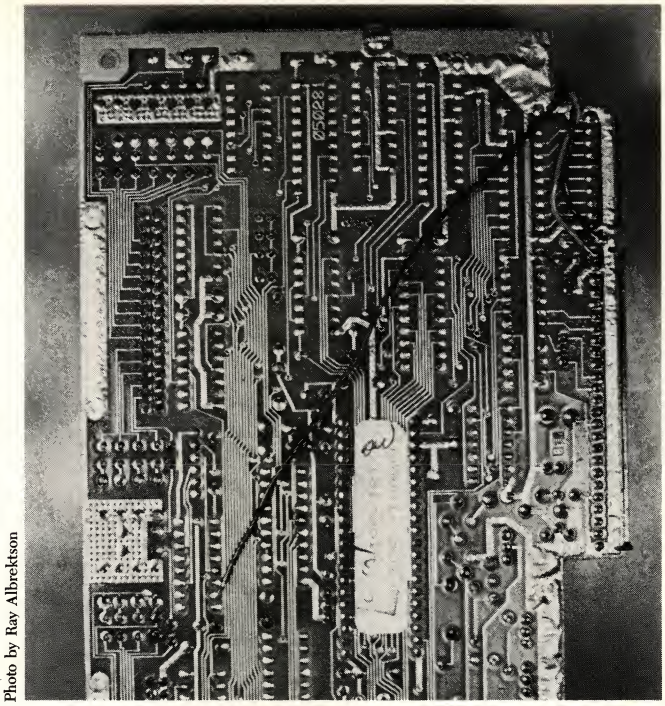

Photo by Ray Albrektson

Photo 2. The back of the H37 controller board shows the ground wire soldered to the back of pin 2, and the +5-volt wire soldered to the back of pin 1 of the large 25-pin bus collector.

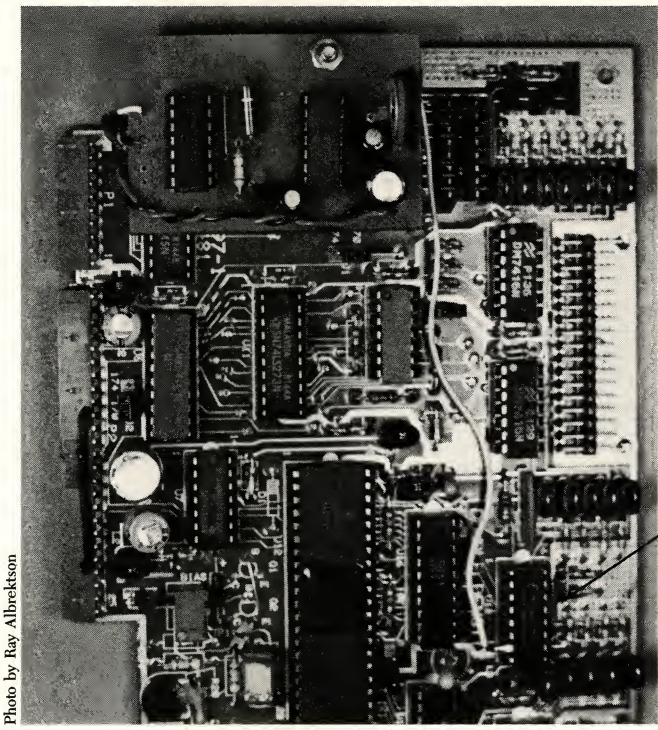

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Photo 3. The arrow points to chip U13 on the H37 controller board, shown here with pin 7 sticking out horizontally.

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* Specify monitor type (i.e. ZVM-135)

CASSETTE INTERFACE FOR H/Z89 or H8

TAPEIO is a multi-function utility which allows one to interface with a cassette tape to backup/restore a CPM file, convert a B. H. BASIC program to a CPM file, convert a TED text file to a CPM text file or verify a tape file. Requires CPM and the cassette board for the H8 or H/Z89. The cost is only $39.95.

To order send a check or money order for the appropriate amount (no CODs or charges) to Kandueazy Computer Software Services (KCSS), 6218 Blossom Lane, Alexandria, VA 22310. Please add $2.50 for shipping and handling. Virginia residents add 4% sales tax. FREE CATALOGUE

SPECIAL: Box of 10 3M DSDD diskettes with flip-and-file case only $19.95 each (quantity limited).

Circle #170 on Reader Service Card

```
RDYH37D:
     MOV  A,B        ;CHECK IF TIME UP
     CMP  M
     JNZ  RDYH37C    ;BR IF NOT
     MOV  A,C        ;TIME UP -- CHECK # OF HOLES
     CPI  1*2
;    JC   RDYH37E    ;IF < 1 THEN ERROR
     JC   RDYH37     ;NEW CODE-- IF < 1 THEN RETRY
;    CPI  3*2+1
     CPI  9*2+1      ;NEW CODE-- ALLOWS FOR AS MANY AS 9 HOLES
     CMC
     JNC  RDYH37F    ;IF <= 3 THEN OK (NOW CHANGED TO <= 9)
```

Listing 1. These changes to the CP/M 2.02.03 BIOS will help avoid SELECT errors once your HSA is installed. The old lines are left in place but are commented out by a semicolon, and the replacement lines immediately follow the old.

place. The program should show a series of 1000s (or nearly) if the drive speed is set properly.

Now remove the soft-sectored disk (leaving ROTATE.COM running) and insert a hard-sectored disk. ROTATE.COM will be producing only one of three possible outputs:

1. A series of 1000s, showing that the HSA is working properly; the disk controller thinks a soft-sectored disk is in place.

2. A series averaging around 100. This indicates that hard-sectored pulses are getting through, and that R1 needs adjusting.

3. A series of wildly variable but low values. This also indicates the need for R1 adjustment.

Experimentally shift R1 back and forth from the preset position and observe each of the above three conditions. R1 should be set to the middle of the range that produces a string of 1000s.

If you don't have ROTATE.COM or an equivalent, you can still determine the optimum setting for R1. Just find the high and low settings where the '89 will no longer boot a bootable soft-sectored disk. Then set R1 halfway between those two points.

At this point the hardware work is over, but a slight adjustment in CP/M's BIOS will be required before you start gleefully using all those old hard-sectored disks.

Make a BIOS change

The reason for a BIOS adjustment lies in the fact that the adapter takes a small but finite amount of time to determine whether or not a hard-sectored disk is in place and to switch over accordingly.

There is a section in the BIOS listing of CP/M Version 2.2.03 (and presumably other versions as well) called RDYH37; this has the job of checking whether a drive is ready for use. If RDYH37 judges that the drive isn't ready, a SELECT error results. Our adapter can cause the stock version of RDYH37 to issue these pretty frequently, especially in situations involving rapid reads and writes between hard- and soft-sectored disks.

Consider a situation where a soft-sectored disk is in A: and a hard-sectored disk is in B:. At some point, the computer will turn its attention from the A: drive to the B: drive, and RDYH37 will be called to check if B: is ready. RDYH37 counts index pulses for two disk revolutions; if the number of counts isn't within the expected limits, a SELECT error results.

With the adapter in place, a number of hard-sector pulses can and will slip through before the internal switchover takes place. The result? A SELECT error.

A similar problem occurs when the computer turns from a hard-sectored to a soft-sectored disk. The switchover time is long enough that the BIOS will think that no disk is in place, resulting in another SELECT error.

The cure is to change two lines in the BIOS. Listing 1 shows a section of the BIOS from RDYH37. Note that in each case the original code remains in place; it is deactivated and turned into a comment line by the placement of a semicolon in front of it. The replacement code is the line immediately following the original, deactivated, line.

The first change causes the BIOS to re-try any error caused by too few index pulses. This error would most likely occur when switching from hard- to soft-sector. The second change takes care of soft-to-hard transitions by allowing a larger number of pulses to come through before declaring a SELECT error.

The BIOS modification to avoid a SELECT error does have one unfortunate side effect. If there is *no* disk inserted, it will try indefinitely. If that happens, and a disk is later inserted, then a SELECT error will result.

I suppose some further BIOS modification could solve this problem. The result in either case, though, is an unrecoverable error; so, it just doesn't seem worth it.

The moral is: never select an empty drive!

Assembling a New BIOS for an H89 with H37 Drives

Collect the following files on a bootable but otherwise empty disk:

MAKEBIOS.COM
ASM.COM
PREL.COM
BIOS.ASM
SUBMIT.COM
SYSGEN.COM
MOVCPM37.COM

Then make a SUBMIT file (call it MAKE.SUB) that contains the following list of instructions:

```
MAKEBIOS A:1 A:
ASM BIOS.AAZ
REN A:BIOS.HX0=BIOS.HEX
MAKEBIOS A:2 A:
ASM BIOS.BBZ
REN A:BIOS.HX1=BIOS.HEX
PREL A:BIOS A:
MAKEBIOS A:3 A:
MOVCPM37 * A:
SYSGEN
```

To make the new BIOS, enter SUBMIT MAKE. The process will stop in the middle of SYSGEN and ask you which disk to use as the source for the BIOS to go on the disk in A:. Just give a carriage return. To the question, COPY BIOS? (Y/N), enter Y. Finally, when SYSGEN asks for the name of the destination disk, enter A and the updated BIOS will be written to the disk in A:. Reboot and run CONFIGUR.COM to meet the needs of your system.

And re-use those old disks

After remaking the BIOS, the job is done.

Let me make one point very clear, as perhaps I should have done in the very beginning: This gadget will *not* read a hard-sectored disk that has been formatted on an H17 controller. A SELECT error will always result. It *only* enables you to use ten-hole disks in a soft-sector environment.

But that's enough to allow saving some money on disks. And my H89 is now totally oblivious to the number of holes in the disks I feed it. I have even begun to format my single-sided single-density disks as double-sided. I have not noticed any decline in reliability—although I admit those are the ones earmarked for my kids to play around with. Best of all, I don't think I'll need to buy new disks for several years. And the pile in my bottom drawer is getting back into circulation. △

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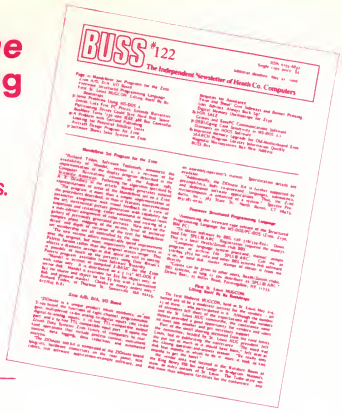
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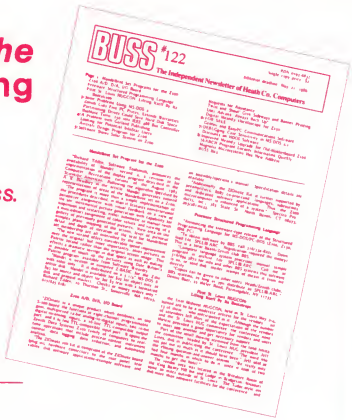
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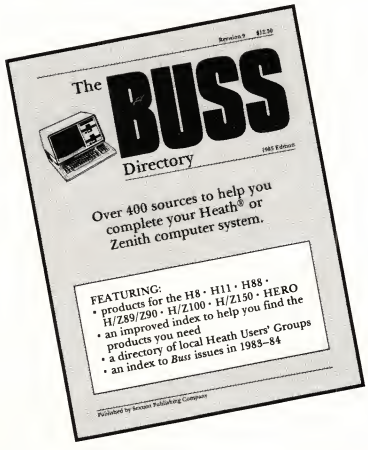
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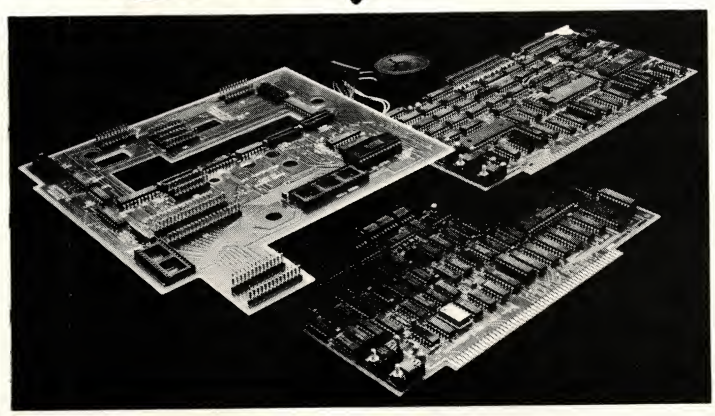

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Z100 Notebook

William N. Locke

Version 3 of MS-DOS

The UCI EasyPC

The second page of video

Version 3 of MS-DOS

Finally, MS-DOS 3 is here for the Z100!

I have had a ritual for about six months now of calling the local Heath/Zenith store and asking if the new operating system for the Z100 was available. The answer has reliably been, "Next week."

Well, to my shock, next week finally arrived. I purchased the new operating system and the 3.0 version of the Programmer's Utility Pack.

This new version of the Microsoft Disk Operating System is loaded with new features and fixes of the old version. I am really only just starting to use it, but allow me to pass on what I have found thus far.

One of the most interesting of the new features is that the command line may contain a path designation for the executable file. It is no longer necessary to specify a path using "PATH = ".

If you want to run a program that is not in the default directory, the following command can do the job:

A:\MS-DOS\BIN\UTIL\PROGRAM

Here, PROGRAM is an executable file in a directory, UTIL, which is three levels down from the root directory on drive A:. The PATH command will still work if you want to set up a permanent search path for use with commands.

Other new features include:

ATTRIB—This allows you to make a file read-only or remove the read-only status. ATTRIB will allow you to protect an individual file against erasure by accident or tampering. Not a bad idea if your computer is touched by people, like me, who make mistakes.

COUNTRY—Now you can set the date and time format for other countries. These formats differ in the order that the month, day, and year appear and in some of the punctuation used in the time. Our 3-23-1983 would be translated into French as 23-3-1983, and 8:00:23.80 would be 8:00:23,80.

You specify COUNTRY as a command line in your CONFIG.SYS file. At boot-up, it will be executed along with any other commands there to configure system characteristics.

(My copy of MS-DOS 3 also came with a note telling me that the CYPHER utility is not allowed to be sold with MS-DOS because of export restrictions. I guess that Zenith is getting big on shipping the Z100 elsewhere. I sure wish they shipped more Z100s in the USA.)

JOIN—The JOIN command is used to give a disk drive a name other than the drive designation. For example, drive B: could be renamed BILL, and that name could be used in place of the normal drive designation.

The drive that is renamed cannot be the default drive. Also, the name the drive is given cannot be a subdirectory in the default directory (unless that subdirectory is empty).

The following example gives the name BILL to drive B: and copies a file named MYFILE.DOC to it.

```
JOIN B: \BILL
COPY MYFILE.DOC BILL
```

LABEL—At last the operating system comes with a command to change the labels given to disks when you FORMAT them. LABEL is late in coming as far as I am concerned.

(By the way, there is a nice utility available to do this job with MS-DOS 2. Ray Duncan's LABEL was published last year in *Doctor Dobb's Journal*. It can be downloaded from the DDJ Forum on CompuServe.)

LASTDRIVE—This CONFIG.SYS command is used to tell the operating system what the last drive in the system is. The default last drive is E:.

SHARE—This command has been added to facilitate the use of local-area networks. (The manual points out that you also have to buy the hardware and software needed to make a LAN. The costs involved in that evolution make this command a feature for study by somebody else.)

SUBST—This is a great command. You may have software that is vintage MS-DOS 1.0—it can not access a subdirectory because it does not understand all those backslashes. If that's your problem, this command is a breath of fresh air. You can substitute a drive letter for a path name, then use that drive letter to access the path name.

As an example, the command:

```
SUBST E: A:\Z100 NOTEBOOK
```

would allow a program to access the directory NOTEBOOK as drive E: independent of the current directory.

This command makes the directory tree structure much easier to use.

FC—The file-compare instruction has several added switches that allow you to display line numbers and vary the internal line buffer.

You'll see one improvement here when the two files being checked are the same. FC now tells you that they are the same rather than quitting without a word—as it did with version 2 of MS-DOS. I never knew if FC had really worked.

LIB—There is one major improvement

here. You can now combine two libraries into one. When large libraries of program modules are involved, this cuts down on the time spent linking them to produce an executable version.

In addition, the libraries containing many small modules are considerably smaller if they are formed with the new LIB command. I have one library consisting of about 160 modules that required 113 kilobytes under the previous LIB system; it requires only 80K with this system.

LINK—The LINK command now supports the use of overlays, which is a major improvement. This means that parts of a running program can be left behind on the disk until needed. A region of the program memory is used for swapping run-time modules in and out. This feature will be discussed in a future "Z100 Notebook."

PRINT—The PRINT command has been modified to give the user control over a number of control parameters through the use of switch commands on the PRINT command line. You can now vary the spooler's buffer size, the maximum number of files that can be stored in the list of files to be printed, and the time-slice parameters that specify what fraction of time the computer allocates to the printing activity.

For example,

```
PRINT /B:16384
```

sets the buffer size to 16,384 bytes (the largest it can be).

```
PRINT MYFILE.DOC /P:60
```

will print MYFILE.DOC with 60-line pages.

The use of the colon in the switches is also a change from MS-DOS 2.

ASSIGN—The command ASSIGN is now used to re-map logical drive names to different physical drives—the function that the MAP command had in the MS-DOS 2 series. A new command, ASGNPART, is now used to assign partitions on a hard disk. These changes were made to gain compatibility with other MS-DOS computers.

VDISK—This is the new version of the virtual, or memory, disk that comes with MS-DOS. It replaces the old MDISK.

This new memory disk is much more flexible. Using the DEVICE command in the CONFIG.SYS file, you can now specify the disk size, the sector size, and the directory size. As an example, the following command would install a virtual disk in random-access memory (RAM); it would specify a size of 500K, a sector size of 256 bytes, and a maximum directory of 100 entries:

```
DEVICE = VDISK 500 256 100
```

Obviously, you must have enough memory to allow space for your virtual disk and to run your program. As yet no virtual-disk device driver exists that will create its own physical memory. Not a bad idea though.

FORMAT—The FORMAT command now automatically formats a disk with nine sectors per track. You no longer need to specify the /9 switch to make this happen. If you want eight sectors, specify /8 following the FORMAT statement. I have been using nine sectors for a long time now without any trouble. I really don't know why anybody would use eight.

The manual—The manual has been rewritten and seems easier to read. (It is still much too fat to fit in the binder provided. I prefer the old large notebooks used with the Z100 software when the machine was young.)

The manual now shows the command name being discussed at the top of each page. This makes the manual much easier to use. I always thought that leaving that feature out of the MS-DOS 2 manual was cruel and unusual punishment.

One of the first things that I did with the Programmer's Utility Pack was see if the BSE editor would crash with a line length of about 255 or greater.

The answer is that BSE still crashes. *Frosts* the old jaw! They didn't fix a known bug in a new release of the software!

I managed to make BSE crash four times in one hour of attempting to use the word processing mode. I still do not recommend this mode. BSE remains a fine programming editor.

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Circle #235 on Reader Service Card

The UCI EasyPC

I am not sure that I dare admit it in this forum, but one of my Z100s has been downgraded to the level of an IBM Personal Computer. I needed to do so because some software I was testing required an IBM-PC compatible, and all my friends are primarily Z100 users.

(To compare Barry Watzman's design of the Z100 architecture to that of the IBM compatibles is simply not fair. I have always thought the IBM-PC design was a job done before four o'clock on Friday afternoon.)

Well, alas, the IBM is the standard, or so all sorts of people seem to think. If you need to use software or if you create software that many other people use, the IBM PC had better be in the inventory.

I had three choices. Buy a new computer, buy the Gemini board, or buy UCI's EasyPC.

The first choice was out of the question for one reason. Our home's dining room is now entirely taken over by my "shop." It is full. A new computer would mean a new room. For reasons that I need not go into, a new room is not an option. That left the Gemini and the UCI.

I installed my first Gemini last summer for the local Heath/Zenith store. The manager had a board come in, but his technician was busy. I did the installation in about twenty minutes, and I was indeed impressed by the Gemini logo that flashed onto the screen.

Unfortunately, the speed of the system in the IBM-PC mode did not impress me at all. A simple disk directory developed slowly on the screen.

I saw my first UCI EasyPC at the Capital Heath Users' Group Conference held just outside Washington, D.C., in early November, last year. I attended a presentation by Dr. David Cheong, the president of UCI, and he demonstrated his emulator. Needless to say, I was extremely impressed. Within the hour I had purchased one of the packages that he had at the show.

This system actually builds an IBM PC inside the Z100 using three cards: a new disk-controller board, a new video board, and a system board. The system speed is not adversely affected.

The disk-controller board is fully capable of either Z100 or IBM floppy- and hard-disk control. It simply replaces the existing Z100 disk-controller board.

The video board is installed in an S-100 expansion slot, as is the disk controller; the video board co-exists with the Z100 video board in the computer. In the IBM mode, the UCI video board controls the screen as well as a small speaker. This speaker is used for compatibility with the IBM-PC audio functions. It seems to work well.

The system board mounts piggyback over the motherboard, between the motherboard and the Z100's video board.

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```
tog_display(){
        char start_add; /* Start Read Address most significant byte */
        outb(12,0xDC);/* Place a 12 in the address port */
        start_add = inb(0xDD);/*Find the current most significant byte*/
                              /* of the Start Read Address Register */
        start_add = start_add^0x08; /* Exclusive or with 08 hex */
        outb(start_add,0xDD);
        }
```

Listing 1. A C routine to display the other page of video memory on the screen.

```
tog_access(){
      char latch_val;
      latch_val = inb(0xDA);/* Go find the initial value of the latch */
      latch_val = latch_val^0x80;/* Exclusive or latch_val with 80 hex */
      outb(latch_val,0xDA); /* Put the new value in the latch register */
      }
```

Listing 2. A C routine to toggle CPU access between the front and back pages of video memory.

Several chips needed to be moved from the motherboard to the UCI system board.

Total installation time, for me, was about one hour.

I did have a few problems getting the EasyPC to work in my Z100. There were several chips on my Z100 motherboard that had to be replaced. These were in the keyboard-control circuits.

UCI has been absolutely superb in providing technical support. Dialing an 800 number yielded the very people who designed the system. They willingly told me what chips to replace, and my system now works well. UCI has said that the documentation will be expanded to cover these problems, and an updated manual is now available for $15.

You are not stuck with an IBM PC when the EasyPC is installed in a Z100. On bootup, a choice is presented and you choose between the Z100 mode and the EasyPC mode.

In the Z100 mode, the machine acts exactly like the unaltered Z100. In the IBM-PC mode, it acts like an IBM compatible. The one mode will boot up from the normal Z100 version of MS-DOS. The other will boot up either from PC-DOS or from the Z150-series version of MS-DOS. If you try to use the wrong operating system, the machine will lock up.

Now for the old question: "How compatible is compatible?"

I have not tried a long list of IBM-PC software simply because I don't want to spend the money on the stuff. And I don't know what I would do with all the fancy boxes that it comes in.

For the most part I write software, so I will tell you what I have found that works. Direct access of the video memory works fine. All interrupts seem to work as described in Peter Norton's book, *Programmer's Guide to the IBM PC*, and the parallel printer port works fine.

The EasyPC emulates the IBM PC so closely that the whole screen flashes when the screen scrolls, as it does on the IBM. I was told by Dr. Cheong that he intends to eliminate this particular compatibility.

Another thing to note is that you have to use IBM's ANSI.SYS terminal driver. Again, the EasyPC emulates an IBM—not a Z150. When the screen is scrolled in graphics mode, the Z150's ANSI.SYS leaves blue lines on the screen.

I have not been able to make the communications ports work at all using the IBM-PC mode. I have been told that this area requires a small additional board that UCI will be selling shortly. This simply means you cannot do modem or serial printer communications in the IBM mode. For those of you who want to use one of the communication ports for a mouse, though, UCI has a device driver which requires only a small hardware change. Also, UCI says a communications board (and an 8087-support card) will be available in the near future.

The early version of the EasyPC did not work with the NEC V20 microprocessor chip. The latest version of the ROM, 1.61, will work with this chip, and I am using it.

All in all, I'm sold. Nice job, UCI. Now all I have to do is get up the nerve to upgrade my old 192K motherboard to 768K, and I'll be ready to take on all IBM-PC software.

As I see it, I now have a CP/M computer, an MS-DOS Z100, and an IBM-PC compatible—all in one computer. It can run at 8 megahertz with up to 768K of memory on the motherboard. I ask you, why would anyone want to sell their Z100?

The second page of video

If you have 64-kilobit RAM chips installed on your Z100 video board, you have a second page of video RAM that can be accessed completely apart from the screen you normally see.

It is actually possible to write on one page while reading the other. This is the trick that some professional software uses to make a graphics screen come on suddenly. While you look at one screen, the computer builds the other screen on the back page. When ready, the computer shows you the back page and writes on the front page.

If you don't have 64-kilobit chips in your video RAM sockets, they can easily be installed. You must also remember to move jumper number J307 to the 64K position. (Be careful not to cross-thread any of the little screws that hold the video board. I once did, and I wound up drilling it out.)

First, I will explain how to shift the display from one page to the other. This may cause the cursor to become lost. You will likely need to use the reset sequence, ESC z, to get it back.

Toggling between displays

The Z100 uses a device known as a CRT Controller (CRT-C) to keep track of the video memory and screen control. This controller chip, a 68A45, reads video memory used for storing green, red, and blue information; it displays the video memory as pixels on the computer's screen.

This chip has eighteen memory registers with which it interfaces to the central processing unit (CPU) through two ports; these registers are used for controlling the CRT-C's operation.

The CPU to CRT-C interface ports are the address port and the data port.

The address port is used for passing to the CRT-C the intended CRT-C register to be accessed. The number placed in this port should be in the range 0 to 17. (The port number is DC hexadecimal.)

The data port is used for passing data between the CRT-C register and the CPU. (The port number is DD hex.)

All of the CRT-C registers and their functions are described in the Z100 Technical Manual, Appendix D, on pages 153 and 154. The only ones that will be discussed here are register 11 and register 12. These, taken together, are the Start Read Address Register.

The Start Read Address Register is used by the CRT-C to fix the point in video memory that will be the memory starting address for the screen. By toggling the fourth bit in the most significant byte, register number 12, we can switch between the starting address that is normal for machine bootup and a start address that represents the back page of memory.

In order to flip the display between the two pages, we need to read register 12. We can toggle the fourth bit by exclusive ORing the byte with the number 08 hex (00001000 binary); then we can write the new value out to register 12.

Listing 1 shows an example of toggling

the display using the C programming language.

In Listing 1, the outb(12,0xDC) sets up the 68A45 for access to register 12; the register is read; the register value is exclusive ORed with 08 hex; and the new value is placed in the register.

Toggling CPU access to the video memory

The Z100's microprocessor, the 8088 CPU, accesses the video RAM through a chip known as a 68A21 Address Latch. This device also uses an internal register to keep track of access to the video RAM. This time, however, the access in question is the CPU's access to the video RAM, rather than the CRT Controller's access to the RAM. This address latch is described on page 4.39 of the Z100 Technical Manual.

If CPU access and display are both directed at the same section of memory, the eight bits of this latch register will match bits 4 through 12 of the Start Read Address described above.

The Address Latch register is controlled through port number DA hex, and the CPU access to video RAM may be changed to the back page simply by toggling the most significant bit in this register. This will be done by using the exclusive OR again.

The C routine in Listing 2 will cause the CPU access to be toggled between the front and back pages. The initial latch value is read; the value is exclusive ORed with 80 hex (10000000 binary); then the value is written back to the register.

A demonstration of page flipping

If you wish to flip between pages, you must be sure to do the following things:

1) Ensure that the terminal's 25th line is enabled, using the sequence ESC x1. In C, fputs("\033x1",stdout) would do the job.

2) Prior to writing on the back page, ensure that you clear the screen and the 25th line on that page.

3) Don't allow the screen on either page to scroll. The scrolling screen will mess up the other page.

4) Turn the cursor off, and leave it off until you are through with the page flipping. Then use the terminal-reset sequence, ESC z, to get the cursor back. The cursor is turned off by using the ESC x5 sequence (fputs("\033x5",stdout) in C).

Listing 3 is an example of the toggling functions. One page is filled with X's, and the other with Z's. The screen is then flipped back and forth between the two.

This example is created for Toolworks C. If you are using another compiler, the port "in" and "out" functions may need to be changed. Consult your compiler documentation.

```
/*                      FLIP DEMO                              */
/*                      William N. Locke                       */

#include "stdio.h"
#define DURATION 30
#define DELAY    30000
main(){
        unsigned  i,j; /* Define two index variables */
        clear_scn();   /* Clear the front page */
        off_cursor();  /* Turn off the cursor */
        fputs("Wait a few seconds, I'm busy out back\n",stdout);
        tog_access();  /* Toggles CPU access to the back page */
        clear_scn();   /* Clear the back page */
        for ( i = 0; i <= 22; i++){ /* Fill the back page with X's */
              for( j = 0; j <= 79; j++)
                    putchar('X');
              putchar('\n');/* This is a RETURN */
              }
        tog_display(); /* Toggle display to the back page */
        tog_access();  /* Toggle access to the front page */
        clear_scn();   /* Clear the front page to clear the "wait" message */
        for ( i = 0; i <= 22; i++){ /* Fill the front page with Z's */
              for( j = 0; j <= 79; j++)
                    putchar('Z');
              putchar('\n');
              }
        tog_display();  /* Toggle display back to the front page */
        for (i =0;  i < DURATION; i++ ){ /* Now flip back and forth */
             for ( j = 0; j <= DELAY; j++ );/* This line acts as a timer */
             tog_display();
             for ( j = 0; j <= DELAY; j++ );
             tog_display();
             i += 1;
             }
        reset_scn();   /* Reset the screen */
        }

clear_scn(){    /* Clear the screen including line 25 */
        fputs("\033E",stdout);   /* Clear the screen */
        fputs("\033Y8 ",stdout); /* Goto line 25   */
        fputs("\033E",stdout);   /* Clear line 25 */
        fputs("\033H",stdout);   /* Go home */
        }

off_cursor(){ /* Turn the cursor off */
        fputs("\033x5",stdout);
        }

reset_scn(){  /* Reset the screen */
        fputs("\033z",stdout);
        }

tog_display(){ /* Toggle the screen display */
        char start_add; /* Start Address most significant byte */
        outb(12,0xDC);/* Place a 12 in the address port */
        start_add = inb(0xDD);/*Find the current most significant byte*/
                              /* of the Start Address Register */
        start_add = start_add^0x08; /* Exclusive or with 08 hex */
        outb(start_add,0xDD);
        }

tog_access(){ /* Toggle the Video RAM access by the CPU */
      char latch_val;
      latch_val = inb(0xDA);/* Go find the initial value of the latch */
      latch_val = latch_val^0x80;/* Exclusive or latch_val with 80 hex */
      outb(latch_val,0xDA); /* Put the new value in the latch register */
      }
```

Listing 3. An example of writing on one page of video memory while displaying the other.

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Circle #126 on Reader Service Card

From FBE: 1216K RAM for Your '151

The Other Vendor made 640K the limit. With MegaRAM-150, you can boost that by 64K and add a 512K RAM disk to boot.

Richard L. Mueller

The standard memory board on the H/Z151 or '161 holds no more than 320 kilobytes of random-access memory (RAM). Do you have a need for more than that in order to run large programs or applications? Or do you need more memory just to run "average size" programs after installing one or more of the memory-resident packages such as SideKick, SuperKey, Genie, etc.?

Or have you thought about RAM-disk capability? Do you need faster file operations (which would give you faster program/application execution)?

My answer was "yes" to all of the questions above. If your answer is "yes" to one or more of them, then stay tuned for information on a product that I installed in my Z161. It has been announced in both *Buss* and *H-Scoop* newsletters, and from my own personal experience I highly recommend it: MegaRAM-150 from FBE Research Company, Inc.

Before I get into MegaRAM-150 details, though, let me first cover some background information on memory limits, memory-chip sizes, RAM disks in general, etc.

Additional memory?

The H/Z151 and '161 use 64-kilobit memory chips on the main memory board. There are sockets for five banks of these memory chips. Each bank consists of nine RAM chips, giving a total of 320K of memory when all the banks are filled. (One chip holds the first bit from each of the bytes stored; another chip stores all the second bits. And so on—eight for the eight bits in a byte, and one for the bit used by parity error-checking.)

So, before the 256-kilobit chips became practical, you needed forty-five 64-kilobit memory chips to get 320K. Again, before the availability of the 256-kilobit memory chips, you had to install a second memory board in the microcomputer in order to go beyond 320K of RAM. The additional board could also contain up to 320K, bringing the total to 640K.

640K is the magic number that you see in all the literature as the maximum amount of memory you can have in the IBM Personal Computer or a compatible such as the '151 or '161. In fact, there are references in some of the manuals that imply that this figure is the maximum supported by the Microsoft Disk Operating System (MS-DOS). However, this is not entirely correct. MS-DOS can support more than 640K; I will explain this in detail shortly. MegaRAM-150 lets you access more than 640K; to be exact, it allows you a total of 704K of main memory.

While it is running, the RAM disk appears just as if it were really an exceptionally fast disk drive.

256-kilobit memory chips

Today, there is a way to upgrade your memory to 256-kilobit RAM chips without adding an optional memory board and taking up a valuable expansion slot in your microcomputer. This involves changing the programmable array logic (PAL) chip at U455 on your main memory board. This chip controls addressing and determines the proper bank when an address is referenced.

There are a number of new PAL chips that will allow the '151 to handle 256-kilobit memory chips, along with the 64-kilobit memory chips. That's right; you can mix the memory chips. One bank can have 256-kilobit chips while another can utilize 64-kilobit chips. If you have a full load of 320K, mixing chips implies that some of the 64-kilobit chips will have to be removed.

As we will see shortly, MegaRAM-150 is a special PAL chip. It lets you install 704K of main memory, and an additional 512K as a RAM disk.

A 640K limit?

Now let's look at this "640K limit" in more detail.

The IBM PC and Zenith's H/Z151 and '161 use the 8088 microprocessor chip from Intel. This chip has 20 bits of addressing—which allows accessing 2^{20} bytes, a full megabyte of memory. However, part of the one megabyte is used by the read-only memory (ROM) containing the monitor routines, by storage for the video display (monochrome and color), etc.

Table 1 is a memory map taken from Zenith's Programmer's Reference Guide for the H/Z151 and '161. As you can see, there are some "holes"; that is, there are chunks of memory space that are not used but are listed as reserved for future expansion. Please note that immediately following the 640K (00000-9FFFF hexadecimal) area is a 64K block (A0000-AFFFFh) that is not used except when the system has an Enhanced Graphics Adaptor (EGA) board installed.

If you do not use an EGA board, then this 64K block can be used to extend your 640K limit to 704K. MS-DOS will recognize this additional RAM and use it if the proper PAL chip is installed and the memory switches on the central processing unit (CPU) board are set correctly. Also, the jumper plug at J401 on the memory board has to be changed when adding 256-kilobit chips and going beyond 320K. See Table 2 for possible chip configurations; memory switch settings on the CPU board are given in Table 3.

Rich Mueller is a senior consultant in the Sales Support group at Control Data Corp. in Minneapolis. He has been working in the computer field since 1961. His home computers are an H100 and a Z160.

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(As it is currently offered, MegaRAM-150 is designed to operate in H/Z151s or '161s that do not have the EGA board. You may want to check with FBE if you have an EGA board or are planning to get one.)

Use a RAM disk

What is a "RAM disk"? It simply means that a chunk of your RAM is used to emulate a disk drive.

However, unlike a true floppy-disk drive or hard-disk drive, the RAM disk is extremely *fast*. The reason is simply that you are transferring information from one section of RAM to another without going through some mechanical device that adds considerable delay.

Unfortunately, RAM is not generally backed up with battery power; so when power is turned off to the microcomputer, the contents of the RAM disk are lost.

Type of Memory	Hexadecimal Address	Decimal Address	Size
User RAM	00000-9FFFF	0000000-0655359	640K
Reserved	A0000-AFFFF	0655360-0720895	64K
Monochrome Video	B0000-B3FFF	0720896-0737279	16K
Reserved	B4000-B7FFF	0737280-0753663	16K
Color Graphics	B8000-BBFFF	0753664-0770047	16K
Reserved	BC000-BFFFF	0770048-0786431	16K
Expansion ROMs	C0000-EFFFF	0786432-0983039	192K
MFM-150 Monitor RAM	F0000-F3FFF	0983040-0999423	16K
Expansion ROMs	F4000-F7FFF	0999424-1015807	16K
MFM-150 ROM	F8000-FFFFF	1015808-1048575	32K
			1024K

Table 1. Memory map of the Z151 and Z161.

Main Memory

Memory Size	Bank 0	Bank 1	Bank 2
256K	256K	—	—
320K	256K	64K	—
512K	256K	256K	—
576K	256K	256K	64K
704K	256K	256K	256K*

*The upper 64K block is not used as part of main memory RAM.

Overlay (or Paged) Memory

Memory Size	Bank 3	Bank 4
256K	256K	—
320K	256K	64K
512K	256K	256K

Table 2. Memory configurations possible with MegaRAM-150.

Memory Switch Positions

Memory Size	0	1	2	3	4
256K	right	left	left	right	right
320K	right	right	right	left	right
512K	right	left	left	left	right
576K	right	right	right	right	left
704K	right	right	left	right	left

Table 3. Memory switch settings on the CPU board.

RAM disks are also referred to as "electronic disks"; I prefer to just call them RAM disks. To the operating system, RAM disks look just like floppy disks, which means they have file-allocation tables and directories. They can even have a pseudo "boot track" to allow you to add the operating system (IO.SYS, MSDOS.SYS, and COMMAND.COM) to them.

RAM disks became a lot easier for programmers to create when MS-DOS version 2 was released with the capability of adding your own device drivers.

I don't want to get into a discussion of device drivers here because that's an article in itself. However, just briefly, a device driver is nothing more than a program that takes care of initializing and reading/writing whatever new device you are adding to your system, and that includes RAM disks.

RAM disks are assigned a drive letter, just as is done with your floppy-disk drives or hard disks. You can read and write to RAM disks just as you would to any floppy disk or hard disk.

Up to this time, perhaps the chief drawback to using a RAM disk is that it has taken a chunk out of your valuable RAM space. With MegaRAM-150, however, that is not so.

MegaRAM-150

Now let's take a closer look at MegaRAM-150, the main point of this article.

MegaRAM-150 not only allows you to go to 704K of RAM (main memory); it also allows you to add up to 512K of RAM-disk space over and above your 704K main-memory RAM. I installed MegaRAM-150 with the full amount for main memory (704K) and the full amount of memory for the RAM disk (512K), and I'm quite pleased with all this memory.

As far as hardware is concerned, MegaRAM-150 itself consists of just the MR-150 PAL chip and a small jumper wire. The product does not include the 256-kilobit memory chips. This is generally true of PAL products: the memory chips have to be purchased separately.

When other PAL products are installed, the jumper plug at J401 has to be set in position 2 to allow more than 320K of memory. However, MegaRAM-150 does not actually use this jumper; the instructions tell you to either remove the jumper plug or put it on the leftmost pin of J401 just to get it out of the way.

The small jumper wire (E-Z-Hook) included with MegaRAM-150 has "hooks" on both ends. One end is connected to the rightmost pin of J401 and the other to pin 10 of chip U458. I have connected the jumper this way. In *H-Scoop*, however, Henry Fale pointed out that it might be better to solder a jumper for a more permanent connection. (See *H-Scoop* #67, October 1985.) The choice is up to you.

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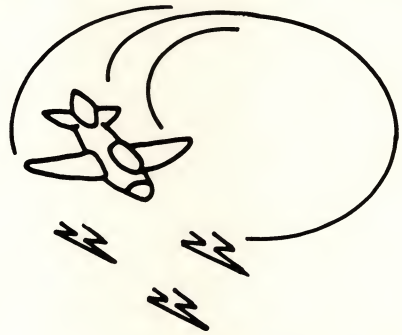

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As I said before, you can take the main memory up to 704K—by installing 256-kilobit memory chips in banks 0, 1, and 2. The upper 64K block of bank 2 is not usable since this portion of memory (addresses B0000-BFFFFh) is used partly by the monochrome video board. So, you can only go to AFFFFh—which is 704K. In addition, you can go to 512K of RAM-disk by installing 256-kilobit memory chips in banks 4 and 5. (Once again, see Table 2 for the possible memory configurations, and Table 3 for memory switch settings on the CPU board.)

Straightforward installation

Once the hardware is installed, the next thing that needs to be installed is the software. Just as with other RAM disks used on the '151 and '161, MegaRAM-150 requires a device driver. The device driver, MR150.DVD, comes with the MegaRAM-150 product, and should be copied to your bootable system disk.

In addition, the CONFIG.SYS file should contain the following entry:

DEVICE = MR150.DVD X

Here, X will be either A, B, or C to represent 256K, 320K, or 512K, respectively, of RAM-disk memory.

The distribution disk contains the CONFIG.SYS file with 512K (C) specified in the command line given above. If you do not currently have a CONFIG.SYS file on your bootable system disk, then you can copy this file to it. If you do have a CONFIG.SYS file, just add to it the line given above.

Reboot your system; you should get a message stating that the MegaRAM-150 RAM disk is installed:

xxx KByte MegaRAM-150 Memory Disk Installed as Drive y:

Here, "xxx" will be either 256, 320, or 512 (depending on what you specified in your CONFIG.SYS entry: A, B, or C, respectively); "y" will be the next available disk device letter. (In my case, for instance, where I have only two floppy disks, the letter is C.)

You can perform operations on your RAM disk the same as on your other disk drives. Do a DIR C:. You should get the message "File Not Found," which means that no files currently exist on your RAM disk. At this time, also, you will see that MegaRAM-150 gives a label to the RAM disk (which is generally not done with other RAM disks). The MegaRAM label is MR-150 DISK.

Try copying any file to your new RAM disk and do a DIR. Same as any other disk, right?

After installing MegaRAM-150, I did some quick testing of loading programs from an actual floppy disk versus my RAM disk; the MegaRAM-150 is extremely fast. One program (125K) loaded from a floppy disk in 18 seconds. From the MegaRAM-150 RAM disk, it took just two seconds.

What the RAM disk looks like

Now let me spend some time on the internal workings of MegaRAM-150.

First, some preliminary details. MegaRAM-150 uses 512 bytes per sector, the same as the 5¼" disk drives. However, the regular disk drives have two sectors per allocation unit. That is the minimum amount of space a file will take up on disk, and space is parcelled out in multiples of two sectors.

MegaRAM-150 has only one sector per allocation unit. This, I feel, better utilizes the available memory, and less is wasted.

Also, the regular disks commonly have duplicate file allocation tables to keep track of where files are placed on disk. The MegaRAM-150 uses only one.

The MegaRAM-150 RAM disk is defined to be an eight-sector-per-track device. All this is to make a RAM disk look and function like any other disk drive.

Mapping memory

Some of you may be wondering exactly how MegaRAM-150 manages to give you a 512K RAM disk without taking up any of the memory space available to your application program and the operating system. After all, RAM disks usually reduce the amount of memory available for other purposes.

The nice part, of course, is that the user does not really need to worry about the details. While it is running, the RAM

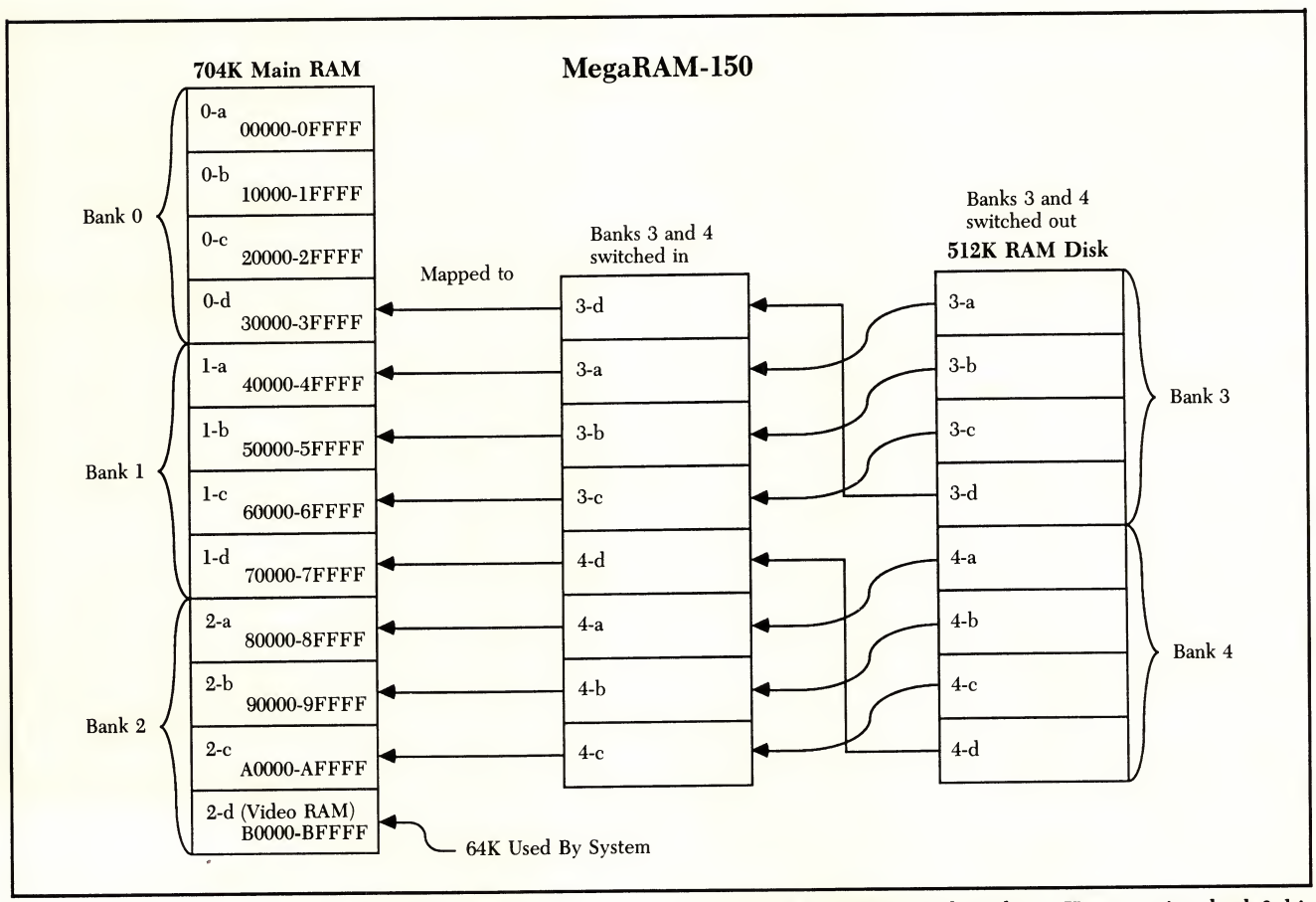

Figure 1. When banks 3 and 4 are mapped from the MegaRAM-150 RAM disk to main memory, blocks 3-a through 3-c are mapped into blocks 1-a through 1-c, and blocks 4-a through 4-c are mapped into blocks 2-a through 2-c. However, since bank 2-d is not available as user memory, the "d" blocks do not get mapped in sequence: block 3-d maps into 0-d, and 4-d maps into 1-d.

disk appears just as if it were really an exceptionally fast disk drive, quite external to the computer.

But for those of you who want to go a bit further, take a look at Figure 1 to get a feeling of what I will be talking about next. I will be referring to it to try to explain how MegaRAM-150 utilizes the memory in banks 3 and 4.

MegaRAM-150 does not use any of the reserved blocks of memory to access the extended memory. Instead, it uses a memory-address re-mapping technique to access the 512K of additional memory.

Briefly, the RAM-disk memory is accessed by MegaRAM-150's device driver rather than by the user program directly. In effect, the device driver stands between the operating system and the memory chips. When your program wants to read something from a RAM-disk file, the device driver will intervene. The driver re-maps the RAM-disk addresses to ones recognizable by the operating system. Then the driver goes to those addresses to read or write to them.

Now to the details. Each 256K bank is divided into four 64K blocks. In Figure 1, the banks are labelled 0 through 4, and the blocks within each bank a through d. So, I will refer to the first 64K block in bank 0 as block 0-a; the second block will be referred to as 0-b, and so on. The full 704K main memory is contained in banks 0 through 2, blocks 0-a through 2-c.

As is noted in Table 1 and Figure 1, block 2-d is not treated as part of user memory; the system uses it for the monochrome video memory. Since it is unavailable, there are some peculiarities in the way the re-mapping of extended memory is handled. When banks 3 and 4 are re-mapped into the lower banks (as shown in Figure 1), they are mapped into addresses 30000h through AFFFFh (blocks 0-d through 2-c).

That re-mapping causes an "a" block to map into an "a" block, a "b" block into a "b" block, and so forth. For the most part, this is in sequential order, 3-a into 1-a, 3-b into 1-b, etc. However, the "d" blocks get mapped out of sequence because block 2-d cannot be used. So, block 3-d maps into 0-d, and 4-d into 2-d.

There is no need for the user to worry about this peculiarity; the MegaRAM-150 driver takes care of it. As soon as the read or write is completed, MegaRAM-150 maps the addresses back to normal.

I should note that absolutely *no* memory is over-written with this technique; only memory addresses are re-mapped. When MegaRAM-150 performs the re-mapping in banks 3 and 4 to read or write the additional memory, the original contents of banks 0 through 2 (blocks 0-d through 2-c) are left intact.

This memory re-mapping is controlled via bit 3 of the memory's parity input/output (I/O) port (address 100 hex). Setting bit 3 to 1 will re-map the additional memory as described above. The contents of the additional memory can then be referenced through addresses 30000h through AFFFFh. Setting bit 3 to 0 will cause the re-mapping to be reset; the original contents of addresses 30000h through AFFFFh can then be accessed.

Shifting gears

When a request is made to read or write the additional memory (i.e., the RAM disk in banks 3 and 4), the MegaRAM-150 device driver first sends out a "function byte" on I/O port 100h; bit 3 is set to 1 in order to cause the re-mapping of banks 3 and 4.

On a read operation, one 512-byte sector at a time is read into a buffer in the device driver's memory space. Then the additional memory is mapped out, i.e., reset to the original banks; the contents of the device driver's buffer are then transferred to the requesting program's disk memory buffer. If more than one sector is to be read in, then the process is repeated, starting with the re-mapping.

The process is similar for writing. First, a sector of information is read from the program's disk-buffer space into the device driver's buffer. Then the re-mapping takes place by sending a function byte (with bit 3 set to 1) on I/O port 100h. The contents of the device driver's buffer are then written to the additional memory, i.e., the RAM disk. The mapping is then re-set. If more than one sector is to be written, the procedure is repeated for each sector.

There is, then, a double moving of data: from additional memory to the device driver's buffer to the user program's buffer (or from the user program's buffer to the device driver's buffer to additional memory). Because of that, this RAM disk is somewhat slower than a RAM disk that occupies some of the main memory space. However, it's really hard to tell; the RAM disk is still extremely fast.

That's basically how MegaRAM-150 works. Some additional information is provided in the MegaRAM-150 User's Guide.

Is it for you?

If you need additional main memory and/or a RAM disk for better operations, I highly recommend MegaRAM-150. It will allow you to install the maximum main memory possible and a maximum of 512K RAM disk without adding an additional memory board.

Good luck, and happy computing.

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Circle #147 on Reader Service Card

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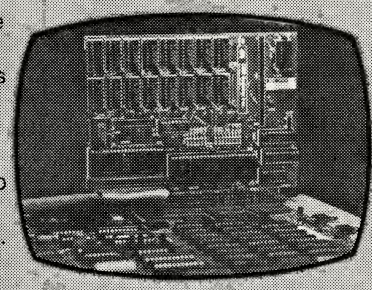
Ram 89 comes as a two card set that plugs into the left hand (16k expansion) side of the computer. No computer modifications required.



Board 1 has two banks of 256k chips possible for a total of 512k. Either or both banks are able to use 64k chips instead. Board 1 can be used by itself, with board 2 added at a later date.

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FOR THE H/Z89-90 COMPUTERS

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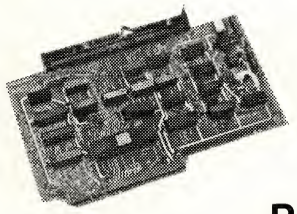

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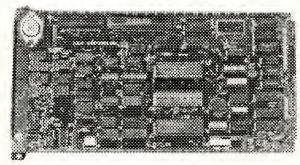

Has all of the capabilities of our popular FDC-880H controller, with added features:

- Direct memory access (DMA) data transfer.
- Hard sectored controller (H17) incorporated on the board.
- Runs with the standard 8080 CPU card and with Z80 CPU upgrades.

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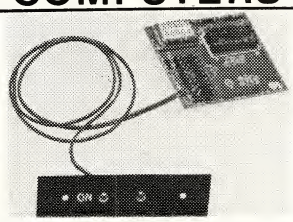
Allows owners of the FDC-880H or the FDC-H8 to read/write to the following disktypes:

Access S.S.D.D., Cromemco S.S.D.D., DEC VT180 S.S.D.D., IBM PC/Zenith 100, (CP/M) D.S.D.D.*, Kaypro II S.S.D.D., Morrow Micro Decisions S.S.D.D., NEC PC-8001 A S.S.D.D., Osborne S.S.D.D., Osborne S.S.D.D., Otrona D.S.D.D.*, Zorba D.S.D.D., TI Professional S.S.D.D., TRS-80 Model I (Omnikron CP/M), TRS-80 Model III (MM CP/M), Xerox 820 S.S.D.D., Zerox 820-II S.S.D.D. Plus more, Standard (Tests for H/Z37 and C.D.R. Disk types)

PRICE $49.95

FOR THE Z100 COMPUTERS

THE ORIGINAL Z100 SPEED MODULE. RUN YOUR Z100 PROGRAMS FASTER



The ZS100 runs the Z100 CPU 50% faster, (7.5 MHZ) in 8088 mode. The ZS100 installs easily with no soldering. The ZS100 is externally switchable between speed mode and normal. The ZS100 improves the time performance of applications packages with no software modifications needed. The ZS100 is for all Heath/Zenith 100, 110 and 120 series computers.

New: a powerful floppy drive package for any computer that can use 8" floppy drives.

Two extended technology 5.25" drives in a package with interface cables case and power supply, with the capability of looking exactly like two standard 8" drives to the computer.

Now have **2.4 megabytes** of **5.25" floppy file storage capacity** in one package. A switch enables the drives to look like 8" drives or 5.25" 96 TPI drives.

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San Diego, Ca. 92111 Phone (619) 560-1272 or contact a Heath/Zenith dealer that carries the C.D.R. Systems Inc. line of products.
New - C.D.R. Systems Bulletin Board (619) 560-8929

Circle #108 on Reader Service Card

A Low-Budget Data Base for HDOS

If you have fewer than 250 records to store, why pay more than $30?

Robert L. Schlessman

Data Base—A structure in which to collect information on a given subject in one or more files.
Data Base Management System (DBMS)—A program enabling you to store, manipulate, and retrieve your information contained in data base files.

In the two and a half years that I have been involved with computers, I have accumulated quite a library of programs, magazines, and sales literature for various products. The bulk of the programs are ones that I don't use regularly, but I use them often enough to justify saving them.

I also find myself constantly thumbing through back issues of *Sextant*, *REMark*, and *Popular Computing* for that article that I know I've read in one of them and that I know is the answer to my latest software or hardware problem. Then there are the times when I've finally saved enough for some piece of software and I can't remember who sells it or which catalogue it's in.

In the midst of all of this disorganization, I realized I was spending too much of my "computer time" searching for needed information. What I needed was a data base management system—although I didn't know at the time that this was the proper name for it.

After several tries at writing my own DBMS, I was no closer to the solution. Benton Harbor BASIC was too slow and limited for efficient data base management. I couldn't afford Microsoft BASIC, and I'm only a novice assembly-language programmer.

So I turned to the various software sources for a solution. This approach was not without its obstacles, either—the largest being price. The programs were all expensive and for use under the CP/M operating system; I rely on the Heath Disk Operating System (HDOS). The several hundred dollars for CP/M and any of the available options in a DBMS was totally out of the question.

Moreover, I needed only a small DBMS: one that would have to handle only a few hundred items in a single data base—although it would be valuable if I could search multiple data bases for information. And I just needed a data base: I wanted only to find and organize my information. I didn't need to handle such "extra" tasks as printing out mailing lists.

Then I came across an article in *REMark* entitled "Keyword-based Filing and Retrieval," written by a gentleman named Jim Tysinger. (See *REMark* #42, July 1983, page 13.) It was very informative and dealt with just the type of data base handling in which I was interested. I could assign one or a number of keywords to a record and then retrieve records based on the keywords.

I didn't need to handle such "extra" tasks as printing out mailing lists.

In his article, Mr. Tysinger referred to a program he wrote, AUTOFILE DBMS, which seemed to be just what I needed. It is offered by the national Heath Users' Group as HUG part #885-1110.

I looked it up in the HUG catalogue and there it was—a DBMS for only $30. The price, coupled with a high rating from HUG, convinced me. I put AUTOFILE on my Christmas list as a top priority desire. My wife, Mary, came through, and by the first week of January I was well on my way to organizing my wealth of information.

To buy AUTOFILE, the first thing you need is membership in HUG. This can be obtained with the application in the Heathkit catalogue. (Besides an excellent monthly magazine and a large library of software, there are many other services available through HUG.)

AUTOFILE runs on both the H/Z89 and H8 computers. For H8 systems, it requires a Z80 central processor as well as the H/Z19 terminal. AUTOFILE makes extensive use of the Heath/Zenith screen format and function keys.

The AUTOFILE DBMS package as you receive it from HUG consists of two disks. Disk 1 contains the five executable program modules, AFL.ABS, AFBSE.ABS, AFSTR.ABS, AFUTL.ABS, and AFDTL.ABS. All five must be present on the same disk in order to run AUTOFILE DBMS; together, they take up 15 kilobytes of disk space. HDOS and at least 48K of memory are required.

Also on Disk 1 are all of the documentation files and a very good tutorial example of how to use AUTOFILE.

Disk 2 contains all of the source listings of the program modules and the necessary common assembler routines (.ACM files). AUTOFILE is written in Z80 assembly language to optimize speed and efficiency. Therefore, you would need a Z80 assembler to do any modifying of the system.

One disk drive is adequate; however, an additional drive would allow for larger data bases.

The documentation contained on Disk 1 is very thorough and easy to understand. It assumes no previous experience with data base management on the user's part. At the same time, though, it is not too elementary to be useful to the advanced user. The tutorial mentioned previously does not cover use of all of the commands and utilities, but it does give you a very good start.

Except when you set up a new data base, AUTOFILE is totally menu driven. I have found, as I am sure many of you have, that this method of command entry greatly simplifies the use of any software package, and the use of single-keystroke entries makes it even nicer.

Just hit the function key f2 to search items by keyword, for instance, and AUTOFILE will prompt you to give it the ones you want. More than one keyword may be designated. For that, you can use the logical AND, NOT, and OR functions,

Robert L. Schlessman is an electronics technician with PPG Industries in Illinois. He is also pursuing a bachelor's degree in computer science.

and any combination of the three; for example, Keyword1 AND Keyword2, Keyword1 OR Keyword2, Keyword1 but NOT Keyword2.

These features make the Keyword search very powerful and versatile.

AUTOFILE's fields

As indicated earlier, AUTOFILE DBMS is a keyword-based filing and retrieval system. (Other search parameters may be specified, but more about that later.)

An AUTOFILE data base may consist of anywhere from 1 to 254 items, with each item containing five data fields. (As mentioned below, the limitation to 254 items can be eased.)

The AUTOFILE fields are Subject, Date, Keywords, Abstract, and a user-defined field referred to as the Display Field.

Figures 1 and 2 show examples of items from two different data bases I've created with AUTOFILE: FILES and ARTICLES. These should give you an overview of the layout of the fields.

There are some limitations on the length and type of data allowed in each field. These are covered thoroughly in the AUTOFILE documentation, but I will briefly cover them here.

Item: The item number is assigned by AUTOFILE. Except when you tell it to delete a file, the item number is strictly for the use of AUTOFILE.

Date: The user assigns a date for each item as it is entered. It must be in the format MM/DD/YY.

Subject: Limited to 40 characters in length.

Display Field: The heading and the field itself are each limited to 25 characters. I use this section for any heading that will make things easier to find—the name of an individual program (in Figure 1) or the source of a magazine article (in Figure 2).

Keywords: Must begin with a letter, be at least two characters in length, and be no longer than 63 characters for each keyword. The only allowable special characters are:

"#$%&'( )*+,–./:;<=>?@

This field may contain any number of keywords, limited only by memory and disk space. (In Figure 2, I could have used the magazine and author's name as keywords.)

Abstract: No restriction as to length. Contains the main body of the item, usually its description.

No control codes (including tabs) are allowed in any field. Each line in the Abstract and Keyword fields is limited to 78 characters; a field is terminated by entering an extra carriage return after a line is completed. The Subject, Abstract, and Display Field fields may have both upper- and lowercase letters, special characters, and numbers.

```
ITEM   DATE   *************** SUBJECT *************** NAME OF PROGRAM OR FILE
  16  1/02/84 UTILITIES                               RENUM.BAS
KEYWORDS:
VOL.3 VOL.9 VOL.10 VOL.21 VOL.31
ABSTRACT:
Source - REMARK / B.H. BASIC program line renumbering utility.

               G RETURN TO HIT LIST DISPLAY
```

Figure 1. An item from the author's FILES data base as displayed by AUTOFILE.

```
ITEM   DATE   *************** SUBJECT *************** TITLE OF MAGAZINE IT'S IN
   1  5/01/83 MODEM TUTORIAL 83                       REMARK
KEYWORDS:
TUTORIALS HARDWARE MODEMS
ABSTRACT:
Part 1 in a tutorial that describes what modems are, how they work, and many
possible ways they can be used.

               G RETURN TO HIT LIST DISPLAY
```

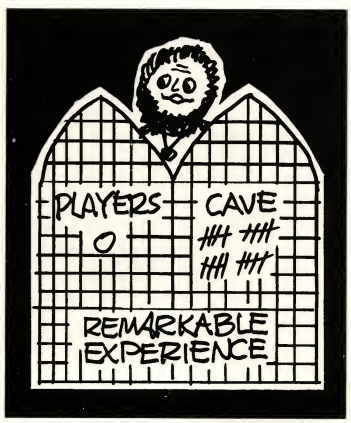
Figure 2. An item from the author's ARTICLES data base as displayed by AUTOFILE.

Setting up a data base

AUTOFILE is executed by typing AFL<RETURN> at the HDOS prompt. HDOS's overlays are loaded along with the printer device driver (LP:). If no printer driver is present on the disk, AUTOFILE will print a message to that effect and prompt you for the name of the file to which printer text should be written. If none is desired, hit RETURN, and all of the printer functions of AUTOFILE will be disabled.

At that point, AUTOFILE prompts for the name of the data base you desire to call up, and you enter it followed by <RETURN>. If the data base doesn't exist, AUTOFILE will tell you so and ask if you

We have an experience for you!



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Hard Disk Systems for H/Z-100's

10 Meg Internal $924

Winchester drive subsystems for Z-100 series computers are available for immediate shipment. The Z-100 system includes a driver for MSDOS 2 and 3 and Winchester utilities; is 100% compatible with all existing software. **New version** of MSDOS driver supports **two drive units** and up to **4 partitions** per drive (each up to 64Mb).

Both internal and external mountings are available. Z-100's with half-height drives are easily adaptable to disk mounting. Internal installation requires some tools, but is straightforward. Please specify whether you have a black or silver power supply. Z-100's with full-height drives will require a replacement bezel from Heath/Zenith; external mountings are recommended for these units. A screwdriver is all that is needed when installing an external system.

Call or write (or circle our number) for further details about pricing, components, mounting methods, etc.

Systems for Z-100 series computers:
Internal mount Winchester drive systems include Host Adapter, Controller Card, Drive unit, Software driver for MS-DOS 2, all cables. External systems also include case and power supply.

10 Megabyte Internal	$ 924.00
20 Megabyte Internal	$ 1124.00
10 Megabyte External	$ 1099.00
20 Megabyte External	$ 1299.00
58 Megabyte External	$ 2299.00

DTC-10-1 S-100 Host Adapter **$ 225.00.** Connects to DTC-510B card, below.

DTC-510 SASI Controller **$ 245.00** New Low Price. Supports one or two Winchester drives.

Software for DTC board set under MSDOS. **$ 60.00** Included free with purchase of DTC 510 and DTC 10-1.

External Case and Power Supply **$ 175.00**

Cable Set for DTC board Set **$ 64.00**

Payment by Personal or Company check, money order, or COD. Shipment by UPS for these items. Please Certify checks. Checks from U.S banks only, please. Shipping is not included in these prices. UPS ground shipment from $ 5.00 to $ 20.00 depending on item shipped and your location.

Circle #118 on Reader Service Card

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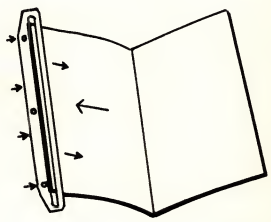
Now you can interface your copies of *Sextant* to a 3-ring binder! Tough plastic Magazine Holders let you preserve, protect, and organize your copies of *Sextant* without drilling holes in them.

Each package of 12 holders costs only $2.95. To order yours, return the coupon with your payment today to Sextant Publishing Co., 716 E Street, S.E., Washington, DC 20003.

Instructions
1. Open magazine to center.
2. Slip pages through slot in magazine holder.
3. Slide holder to center of magazine.
4. Place magazine in any standard 3-ring binder.



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Send me _____ packages of 12 magazine holders $2.95 each. Please add $.75 to your total order for shipping and handling.
☐ Payment is enclosed. (Checks must be in U.S. dollars payable on a U.S. bank.)
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Card # _____ Expires _____
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GRAPH will analyze and plot both data and functions making it the ultimate TOOL for analysis and signal processing for Engineers, Scientists, Students, and other professionals.

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Requires H/Z100, H/Z150, IBM PC/XT/AT or true compatibles, ZDOS or MSDOS, minimum 256K RAM, standard color/graphics card. 8087 numeric coprocessor recommended.

Only $129.95 check or money order, plus $4.00 shipping and handling. Michigan residents add 4% sales tax.

To order (specify computer type, memory size, 8087 option) or for more information write to...

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Plymouth, Michigan 48170

Circle #233 on Reader Service Card

```
* * AUTOFILE * *
AUTOMATIC FILING AND RETRIEVAL SYSTEM
USING DATABASE FILES
    KEY                     FUNCTION
    f1                      SEARCH ITEMS BY SUBJECT
    f2                      SEARCH ITEMS BY KEYWORDS
    f3                      SEARCH ITEMS BY NAME OF PROGRAM OR FILE
    f4                      STORE ITEMS
    f5                      DELETE ITEMS
    B                       DATABASE UTILITIES
    G                       RETURN TO HDOS
```

Figure 3. AUTOFILE's main menu display.

```
UTILITIES
01/02/84
FLAGS.ABS
VOL.1 VOL.2 VOL.3 VOL.6 VOL.7 VOL.8 VOL.9

Source - HEATH / Utility to set the file flags.

UTILITIES
01/02/84
RENUM.BAS
VOL.3 VOL.9 VOL.10 VOL.21 VOL.31

Source - REMARK / B.H. BASIC program line renumbering utility.

DEMONSTRATION PROGRAMS
01/24/84
DEMO.BAX
VOL.3

Source - SELF /

DEMONSTRATION PROGRAMS
02/12/84
FLASHDEM.BAX
VOL.3

Source - SELF / Demo program to turn a word off & on while scrolling it.
Used in the math drill tests.
```

Figure 4. A text file of marked items as generated by AUTOFILE. To create an AUTOFILE data base with your own editor, the files must be formatted as shown.

```
 ITEM   DATE   *************** SUBJECT *************** NAME OF PROGRAM OR FILE
    4* 1/02/84 UTILITIES                               FLAGS.ABS
    5  1/02/84 UTILITIES                               PATCH.ABS
    6  4/27/82 INTERPRETERS                            BASIC.ABS
    9  1/02/84 UTILITIES                               EDIT.ABS
   14  1/02/84 DEVICE DRIVERS                          LP.DVD
->16* 1/02/84 UTILITIES                               RENUM.BAS
   17  1/02/84 UTILITIES                               OCTADD.ABS
   18  1/02/84 UTILITIES                               DLOAD.BAX
   19  1/15/84 PROGRAM LISTINGS                        EDBASIC.ASM
   20* 1/24/84 DEMONSTRATION PROGRAMS                  DEMO.BAX
   21* 2/12/84 DEMONSTRATION PROGRAMS                  FLASHDEM.BAX
   22  1/15/84 UTILITIES                               LBASIC.ABS
   23  3/11/84 GAMES                                   TRAIN.BAX
   24  1/02/84 UTILITIES                               EDBASIC.ABS
   25  4/27/84 EDUCATIONAL PROGRAMS                    ADDTEST.BAX
       f1  DISPLAY INDICATED HIT        f4  DISPLAY NEXT PAGE OF HITS
       f2  PRINT INDICATED HIT          f5  DISPLAY PREVIOUS PAGE OF HITS
       f3  PRINT HIT LIST                *  MARK INDICATED ITEM FOR UNLOAD
( ) SPACE BAR CLEARS UNLOAD MARK FOR INDICATED ITEM
 G RETURN TO SEARCH DEFINITION OR UNLOAD/DELETE MARKED ITEMS G
```

Figure 5. When a keyword search is performed, AUTOFILE produces a "hit list." The hit list above was a result of a keyword search for VOL.3 on the author's FILES data base.

wish to create it. A Y for yes will inform AUTOFILE to do so. As an example, I will use FILES, my disk catalog.

Three files will be created on the disk. In our example, they are FILES.PIF (primary item file), FILES.IDX (index to FILES.PIF), and FILES.INV (keyword inverted file). If you wish to copy the data base to another disk, all three of these files must be copied.

Once the data base has been created, the main menu is displayed. Figure 3 shows the options it presents. With a newly created data base, the obvious choice would be to enter items, so you would press function key f4. You are now asked whether the keyboard will be used to enter the data base items. The other option is to enter the data base items from a text file on the disk.

If the disk-file mode is used, the file must be in the format shown in Figure 4. A text file created by AUTOFILE will always be in this format. (But I am getting ahead of myself. I won't go step by step through the entry of new items from the keyboard since this procedure is covered very nicely in the tutorial.)

Using AUTOFILE

After the desired items have been entered, you are returned to the main menu. The data base may then be searched by subject, keyword, or the user-supplied display-field heading. But the real speed is in the keyword search. A keyword search of hundreds of items takes only seconds.

Referring to Figure 5, you can see an AUTOFILE "hit list." This gives all the records found from a keyword search of my FILES data base. The keywords I use throughout this data base are the volume numbers of the disks that the file or program can be found on.

In the case shown in Figure 5, I did a keyword search for items containing the keyword VOL.3, to find those files on disk volume 3. If I had chosen the "Display Indicated Hit" (f1) option, the record in Figure 1 would be displayed. All hit lists and data base items set up by AUTOFILE are in the formats shown.

You can print all of the possible keywords in a data base, create a text file of all or part of the data base, print hit lists, or print individual items.

There are many other features available with AUTOFILE, among them the option to search multiple data bases on multiple disks.

This feature allows you to circumvent the 254-item limit. Larger data bases can be broken into smaller ones and then searched using the same search keys. AUTOFILE will prompt you to switch disks.

In this regard, it should be noted that the data base itself does not have to be read into memory. The only thing held in random-access memory (RAM) is the Keyword array. This allows for extremely

fast keyword searches.

In case you have a crash, there is also an excellent recovery utility called UNLOAD.ABS. How to use all of these functions is completely covered in the documentation.

Shortcomings

To be fair to the reader, a software review should cover any shortcomings the product may have. AUTOFILE's most frustrating one for me is the hassle involved in modifying an item in the data base. You must first tell AUTOFILE to create a text file of the item, then modify that file with your text editor, then re-enter the item by reading the text file with AUTOFILE.

That can be very tedious when working with a data base such as FILES, where I am constantly adding and deleting files to and from my disks. A way of modifying items within the system would have been a nice feature. (Again looking at the hit list in Figure 5, the items marked with an asterisk are the items to be written to a text file, deleted, or modified.)

In addition, some editors (such as PIE from The Software Toolworks) replace spaces with tabs within an edited file. This is done as a space-saving measure. But, as mentioned earlier, a tab is a control code, and that is a no-no as far as AUTOFILE is concerned.

To be used with AUTOFILE, then, this type of editor must be reconfigured to use spaces as typed. I should mention that ED, HDOS's editor, works fine just as it comes.

Affordable power

AUTOFILE ranks very highly among the software purchases that I have made. As is the case with most of the software from HUG, I have found it to be easy to learn, very well suited for my purpose, and worth a great deal more than the selling price. Jim Tysinger and HUG are to be commended for providing a very powerful DBMS at an affordable price.

AUTOFILE wouldn't be suited for many of the applications of some of the larger systems, such as dBASE II or Friday!. Neither, though, do you have to learn a new programming language in order to use it—not to mention the larger cash layout. I feel that AUTOFILE will meet the data base management needs of many Heath/Zenith home-computer enthusiasts—as well as the needs of many small businesses.

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C Notes

Joseph Katz

Ecosoft's Eco-C88 Release 3.0

Two inexpensive libraries

A transient Z150 screen dump

The Seidl Make Utility

Two C interpreters for the H/Z150

After you say "Hello . . ." Part 5. WSTOASC 2: a polished WordStar-to-ASCII filter

Ecosoft's Eco-C88 Release 3.0

Release 3.0 of Ecosoft's Eco-C88 is a notable advance over earlier versions of this MS-DOS compiler. Of course, it supports all the features defined by Kernighan and Richie—except bit fields. (Few other C compilers for microcomputers support bit fields, none of them suffering from the lack.) In addition, it offers features that likely will be part of the American National Standards Institute (ANSI) standard C: prototyping, structure parsing and assignment, and enum and void data types.

The stated goal of Ecosoft for Eco-C88 is the implicit goal for nearly all microcomputer C compilers: complete portability of source code among different machines. To that end, the Eco-C88 preprocessor includes a switch for Lint-like checking of the code. (Lint is a C program-checker intended mainly to catch insidious little potential bugs that might someday surface, and to ensure portability. Lint is notoriously nitpicking, somewhere between an English professor and a *Sextant* editor in its fussiness over small points.)

Equally implicit a goal of most C compilers for microcomputers is emulation of the C programming environment of Unix, from which microcomputer C derives. Release 3.0 of Eco-C88, therefore, includes a CC program to serve as an executive in taking the user's code all the way from source to executable version, in emulation of the Unix CC.

Noteworthy for the ways in which it succeeds at Unix-like portability, Release 3.0 of Eco-C88 is absolutely remarkable in the ways it meets the needs of C programmers on MS-DOS machines. For example, it comes with a full set of library functions—not only the standard library, but also libraries for such things as ANSI-standard graphics manipulation.

Release 3.0 really shines. The star is CED, a full-screen editor that ought to make Turbo Pascal programmers gasp first with recognition, then with envy.

Yes, one edits, compiles, and links from within CED. Yes, if an error is found during compilation, the cursor jumps to it in CED. Yes, CED explains the error. And yes, CED's appearance resembles the Turbo Pascal editor's.

But the combination of CED and the rest of the Eco-C88 package does so much more than Turbo Pascal (even allowing for the differences between Pascal and C that make C so much more powerful) that Turbo Pascal now looks like only the first generation of "friendly" programming tools.

For example, CED allows work on two files at once. One can, therefore, do things like scavenge routines from old code, or just study it online for workable strategies to adapt for the new. One can also build and recall macros to make work easier; and, to make it easier still, one can call on CED's excellent online help at any time.

The help features of CED are *superb*. Of course, one can ask for aid with the editor's commands: that kind of help is the standard one expects of a good editor. What makes CED's help "superb" is the part that amounts to a complete, online C reference manual for the Eco-C88 library. If one forgets how to use strcpy( ), for example, press CTRL-KJ. When the program prompts "What help:" reply with the name of the function. Up pops a window with the following function digest:

```
strcpy
#include <string.h>
char *strcpy(char *des, char *src)
copy string from src into des
```

That is *elegant* help.

My major complaints about past releases of Eco-C88 were in the areas of error messages and documentation. Both areas are *much* improved in Release 3.0. The manual, for example, has been expanded and revised to make it much more useful than its predecessor.

The Eco-C88 package I've been describing—all of it—is $59.95. Library source code is available in two supplementary packages: C source code for the standard library is $10 (if ordered with the compiler; $20 if ordered later); source code for all the libraries, those written in assembler as well as those in C, is $25 (if ordered with the compiler; $50 if ordered later). I have not seen the source code for Release 3.0, but my recommendation—as usual—is to buy it.

Two inexpensive libraries

Kris Jamsa's C Library probably is the best buy in C libraries right now, and Philip Mongelluzzo's Window Boss might well become a good buy, too. Both are *packed* with usable functions, and both come with source code.

Jamsa's is two disks handsomely packaged in their own storage box. One disk has functions for handling such things as strings, arrays, sorting, pipes, input/output (I/O), pointers, recursion, and a miscellany of mainly math

functions. The other disk has demo programs, including full source code, that are mighty useful in their own right: a tab expander, line counter, word counter, and such. You can use the programs as is, and include the functions in your own programs. The disks are available in MS-DOS format only, but I think the non-MS-DOS-specific functions will run on just about any H/Z machine with just about any C compiler available for them.

What's really special about the Jamsa library, though, is that it is the machine-readable form of examples in Jamsa's book, *The C Library.* The two together make a fine way to follow a fine programmer in action as he develops functions and programs: the source code is *magnificently* commented; the book introduces the code with *excellent* discussions of theory and practice. At $29.95 for the disks and $18.95 for the book, the "package" makes a *superb* self-paced tutorial that is simultaneously useful code and a valuable reference book keyed to it. It's pretty nearly the best of both possible worlds.

Mongelluzzo's Window Boss is much more specialized, but may become a pretty good buy, nevertheless; I'll explain my reservations shortly. Window Boss is a sequel to, and possibly the culmination of, Mongelluzzo's public-domain C Windows library for C86. Both allow one to include really snazzy windows in a program for the Z150 and, therefore, the IBM PC. But the Window Boss has much more advanced windowing than C Windows and has libraries for both Computer Innovations C86 and Lattice C. It allows making popup menus as well as windows; so if you want to do something like Ashton-Tate's Framework or Lotus's 1-2-3, the Window Boss gives you tools to start moving towards the right look.

The Window Boss is distributed as shareware: you can download the libraries' object code and some demo programs from CompuServe on either the IBM Pro SIG (Go PCS 131) or the IBM Novice SIG (Go PCS 129); then, if you like what you see, you can register with Mongelluzzo for $50. For that fee he promises the source code, a year of updates, and new documentation as soon as it's ready.

You'll want the source code if you really want to put the Window Boss to work, in part because windows can be hard to integrate into programs that do more than show a pretty face, and in part because the documentation in its present form is rough and sparse.

Enter the reservations I mentioned earlier. Mongelluzzo says he knows that the present documentation is inadequate, and says he has someone working on better documentation that will be supplied as hard copy: what exists now is a disk file you must print out. The version I have now—01.02.86—also has some rough spots in some modules of the source code: a relatively late attempt at beautification introduced nested comments, which is not a feature of standard C and can drive a compiler nuts. The nests are easy to spot if you know to look for them (you do now), and easy to remove. I've mentioned the problem to Mongelluzzo, and I think he'll probably fix it. Registered users ought to get the fixed versions. Once the package has better documentation and the code is fixed, my reservations recede.

A transient Z150 screen dump

Here's SDUMP, a program for the H/Z150 written to compile with C86:

```
main( )
{
sysint(0x05);
}
```

That's it. That's the entire program.

Change sysint to int86 and the program will compile with Lattice C or Eco-C88. If you use another MS-DOS C compiler, look for the equivalent function—the call for an interrupt—and you'll probably find the necessary adaptation equally easy to make.

SDUMP is a transient program to do a text screen dump, just as if you had pressed Shift Prt Sc. It would be useful should you need a screen dump without operator intervention. I can't think of any other program so short that does anything so dramatic. File it away for when you want to show off your C skills to some innocent bystander.

The Seidl Make Utility

The best way to do any but the smallest C program is to link it together from separately-compiled functions so its main( ) serves as just an executive for the functions. (The sound you hear is me, mumbling Augustus De Morgan's verse about big fleas having littler fleas to bite 'em, and so on *ad infinitem.*)

But that way it's hard to keep track of what depends on what. Lose track after you change one of the subfunctions, and little fleas begin chomping their seniors.

SMK, the Seidl Make Utility, is an MS-DOS descendant of the Unix program designed to manage the entire process of compiling and recompiling a complex program. The idea behind any Make utility is to put in a "makefile" a detailed outline of every step it takes to make the program. (Assemble *those* functions, compile *these*, link *those* and *these* with the libraries over there, then delete any intermediate files we no longer need.)

Of course, you can use simple batch files to do some of that for a simple program, but then either the batch file has to recompile everything every time you make a change or you still have to keep track of program dependencies. A good Make is alert to the most efficient way to keep the program up to date.

SMK is a *very* good Make indeed. Its major distinction is a truly simple "Dependency Definition Language" (DDL), easy to learn and easy to use. With it, one builds the "makefile" in structured "bottom up" fashion, as in Listing 1, a sample SMK makefile. It's a simple example for a simple program, and does not show such SMK features as error handling. All one does in the makefile for an enormously complex program is build blocks like this for each step, and then pile block upon block.

After the makefile is built, debug it. (Makes take everything *literally,* and are as unrelenting as an English professor grading an essay.) Then just put the Make on the makefile whenever the program has to be redone: the command with this Make is SMK makefile. SMK does all the work of checking which files have changed since the last compilation and does only what needs doing.

After getting the hang of things by fiddling around with a HELLO, it took me little more than an hour to do my very first SMK makefile for a complex program. The SMK manual is excellent; the sample files are less useful because they are used to make SMK itself, and since the program source code is not included (of course), one can't give SMK a test run.

If all you do are simple, single-module C programs, you probably don't need SMK, unless you like going first class no matter what. If, however, you take advantage of C's modularity, you'll probably bless SMK. By the way, although Make is one of C's contributions to the good life, you can use SMK no matter what your programming language: if the building of your programs can be described in a makefile with SMK's DDL, you can use SMK to build them and keep them current. No matter what your language, though, the use of any Make program is altogether dependent on your *scrupulous* fidelity in setting the MS-DOS date and time at boot-up. Get a clock-calendar board if you're the kind of user who hits the RETURN key in response to the two prompts. I am, so I did, for the H158. I still must get them for the Z150 and Z100.

SMK works on the H/Z100 as well as the H/Z150 series: the manual doesn't say so directly, but comments in the manual indicate that SMK was developed on the Z100. You need version 2 or higher of MS-DOS because SMK creates BAT files that depend on features not in Z-DOS or any other MS-DOS version 1.

Two C interpreters for the H/Z150

The *only* thing I envy Microsoft BASIC programmers is the ability to use the interpreter (MBASIC, BASIC, or BASICA, depending on your H/Z) for debugging a program before making it stand alone with the compiler (BASCOM, no matter

which machine). When I make a mistake, the edit-compile-link cycle grows old fast. That same cycle also makes C tedious to learn or teach. So, my attention can usually be attracted by a good C interpreter.

Two of those that deserve attention are Living C Personal from Living Software and C-Terp from Gimpel Software, both usable on the H/Z150 (but not on the H/Z100). They are in two different leagues, each good in its own right.

Living C Personal would be most useful when learning C or testing simple functions. Enter the command LIVINGC, and the main menu pops up. Choose E to enter a new program or R to run an existing program. As it runs, the cursor bounces through the source code in a bottom window, while a top window shows what the user normally would see. That's a *marvelous* way to learn operator precedence, for example, because the cursor touches each part of the source code as it is being executed.

When there is an error, the top window disappears and the editor takes over the screen. The cursor marks the spot where the error was caught. Press F1 and another menu appears, from which you can select "Error Help." It's a brief identification of the error class, accompanied by a brief explanation of the error's likely cause.

For those more confident or less patient, it's possible to speed the process by choosing "Interpret" from the main menu. Then all you see is one window displaying what the user of the compiled program would see: because you don't "follow the bouncing ball" of the cursor making its way through the source code, the screen is not constantly updated, and the program runs more quickly. Since Living C is an interpreter, though, execution times always are greater than they would be with compiled programs.

Gimpel's C-Terp approaches things in much the same way, but with a much more stolid face. You don't follow the bouncing ball as the program runs, but when an error occurs the screen flips to where the cursor marks the spot. You're not in the editor then, only in a window onto the source code: select the editor if you'd like to make an immediate change, or enter the debugger if you want to do something like a traceback to find how the program got into its present muddle.

C-Terp is much more sophisticated than Living C Personal, and is more a professional tool than a learning device. Each intepreter includes a library of generalized functions based on Kernighan and Richie, then moves in its own direction for other functions.

One major reason why the two interpreters move in different directions is that each C compiler differs from all

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```
##--------------------  COMMENT  ----------------------------
## SMK makefile for HELLO.EXE in CI C86
## Pathnames are for my H-158
## SMK comment lines begin with two sharp signs

##--------------------  PROLOGUE  ---------------------------
## prologs are optional instructions for setting conditions
## at the beginning of a make: here we clear the screen,
## display a message, and make sure of our starting points.
## (note that any command usable in a BAT file is acceptable
## in an SMK makefile.)
#prolog CLS
        echo off
        echo -- Making HELLO.C with CI C86 --
        echo I'll call you when I'm finished
        D:
        CD\TEMP
        C:
        CD\C86
#end

##--------------------    MACROS   ---------------------------
## macros designed to save work later are defined early
## in the makefile:  those here say that "CC" is shorthand
## for how to execute each of the four passes in CI C86; SMK
## handles much more complex macros than this
#macro CC
       C:CC1 &0
       C:CC2 &0
       C:CC3 &0
       C:CC4 &0
#end

##---------------------- COMPILE ----------------------------
## the business end of the makefile starts here, with
## the first step in HELLO:  making the object file
#make D:HELLO.OBJ
#with D:HELLO.C
#by
      CC D:HELLO
#end

##----------------------  LINK   ----------------------------
## now that the object file exists, we go to the second
## step:  link the object file to the standard library
#make C:HELLO.EXE
#with D:HELLO.OBJ
#by
      C:LINK D:HELLO,,,C:C86S2S;
#end

##--------------------  EPILOGUE  ---------------------------
## the epilog is optional, even if a prolog has been used:
## this epilog does some cleanup and runs a program to tell the
## lazy programmer that everything's been done for him
#epilog
      DEL D:HELLO.OBJ
      SIREN
#end

##
## end of HELLO.SMK
##
```

Listing 1. A sample SMK makefile.

others at least a little in details, especially in assembly-language conventions. The chief attraction in Microsoft's pairing of interpreter and compiler is that both speak roughly the same BASIC. There are dialect differences that cause problems, but apparently only a few and those apparently easy enough to work around. There isn't really a "standard" C yet for microcomputers, only a pretty general agreement on fundamental language features. In practice, I find the divergences live mostly in the realm of nuisance, and work on this column is increasing my acquaintance with ways to handle them. Where the bugs really bite, though, is in the radically different conventions compilers use for calling external functions. To see the result, compile HELLO.C with one compiler and link it with the library for another compiler: you get mutters, sputters, and dire threats, but no executable program.

And yet, what good is a C interpreter that restricts you to functions in its own libraries? No matter how extensive those functions, you won't be able to use the interpreter as a pre-compilation tool for real programs. You won't have access to all the functions in your compiler's libraries—those from which you normally draw.

Living C Personal will access external functions outside its own libraries if they have been specially prepared first. They must be in COM files done according to the format Living C Personal understands: it's the business of calling-conventions again. Specifics of those calling-conventions are beside the point, because the general requirement really is too onerous for external functions to be practical. I don't want to recode any compiler's library just so I can use those functions in an interpreter, and I don't want to code new functions two ways—once for the interpreter and once again for the compiler. So, my attitude towards Living C Personal is that if it don't have the functions, they don't exist. And if they don't exist, I can't use Living C Personal for that program.

C-Terp takes an entirely different approach that makes it really useful as a professional tool. Unlike Living C Personal, which has only one version for all uses, you must specify your compiler when ordering C-Terp. C86, Aztec, Mark Williams, Lattice, and Microsoft 3.0 are all supported. You can use your C-Terp right out of the box, but you can also install it to link in the compiler's own libraries—or any other external libraries compatible with the compiler. I've built a version of C-Terp for C86's small model and another for the big model, and I've also made versions that incorporate some libraries of my own. All that's needed is to add the desired functions to an augment table and run a batch file. It's not difficult, although the amount of available RAM will limit the practical size of a modified C-Terp. (You need a minimum of 256K. My Z150s have 640K. RAM is still cheap: why not stuff the box with all it can take?)

The documentation for both interpreters is adequate. C-Terp's is discursive and personal, which makes it attractive because the personality that comes through (Jim Gimpel's?) is knowledgeable and friendly. Living C Personal's tiny manual is mostly readable and informative, but it has some foggy points—such as just how to make the COM file needed for using external functions—and some minor typos. It's adequate.

I had to call Gimpel for support (because I hadn't declared alloc( ), a novice error which drove C-Terp nuts even though it is supposed to trap for such things) and he patiently helped me find my blunder. (In my defense, the code was old stuff I had written for CP/M, and C86's small memory had no trouble with it, and.... All right. I should declare externals. So should we all.) I wanted to ask Living Software some questions about externals, but the company lives in England and gives only its telephone number there for support. I didn't call.

After you say "Hello . . ." part 5. WSTOASC 2: a polished WordStar-to-ASCII filter

This installment takes the WordStar-to-ASCII filter as far as we'll go with it for now.

Version 1, produced in the preceding installment, was fully functional. It could read the WordStar input file, strip its high-order bits and control characters (the "garbage" referred to in the program's comments), and pump resulting ASCII characters into the named output file. Those things are what a good WordStar-to-ASCII filter ought to do.

But version 1 was merely functional. The only signs of friendliness shown to an erring user were two complaints: if the input file name was in some way wrong, the program said "Can't find the input file"; if the output file could not be written, the program said "Can't make the output file."

Such a spartan program has a few drawbacks.

An obvious inelegance is that there is no way for the user to know that the program has loaded successfully until after the output file is finished and has been examined. There should be some kind of acknowledgement that the user's command has been obeyed correctly. In this installment, we'll add a "banner" to serve that purpose while giving other pertinent information each time the program is run.

"Inelegance" is too weak a term for the program's failure to check before overwriting an existing file with the same file name the user has given the output. That failure is bad programming practice be-

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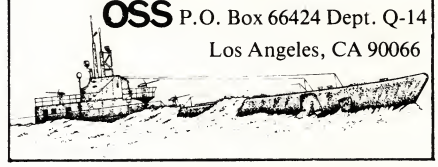

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cause such a program is just plain dangerous: it penalizes forgetfulness with the potential destruction of valuable files. I know that many filters fail to trap for existing files. They are, *prima facie*, bad programs.

One example of such badness is the failure of version 1 to prevent overwriting the input by the output. There are two possible consequences of that failure. If input and output are small enough, and buffered I/O functions are used in the filter, the input will be replaced by the output. That may be what you want—now. On reflection, though, you may think of future uses for the input file: in this instance, the WordStar file. A good filter should give you at least the opportunity to reflect. If the input file is big, or the filter does not use buffered I/O, you will wind up with neither input nor output: once the input file has been opened for output, its contents are destroyed. I know that many filters fail to prevent simultaneous use of an input file as the output. They, too, are bad programs.

So, the way version 2 of WSTOASC differs from version 1 is in a little cosmetics and a lot of error-trapping. The user is not permitted the same name for input and output files, and is prompted before an extant file is overwritten. To make the situation even safer, that prompt accepts only "Y" or "y" as permission to overwrite. Any other response aborts the program.

Although added error-trapping makes version 2 bulkier than version 1, a little trick keeps down the size. The trick is a new function, UPPER.C. (See Listing 2.) It simply uppercases any lowercase letters in a string. The input and output file names are copied from argv[2] and argv[3] into new strings—"inname" and "outname"—which are forced into the same case for comparison with the standard library function strncmp( ). It returns a NULL if the two strings are identical, in which case the program aborts with a remonstrance. Forcing the two strings into uppercase is necessary because a sloppy user—which is *everyone* who uses the program—may intentionally or accidentally use a mixture of upper- and lowercase in file names. CP/M forces command-line arguments to uppercase, but MS-DOS does not. Version 2 of WSTOASC (Listing 3) is written to be safe on either operating system; so it does its own forcing: redundancy here adds to portability.

Note that UPPER.C is a separate function, an #include that is expanded by the C compiler's preprocessor. WPFILTER.H (in "C Notes," *Sextant* #22, May-June, 1986) is handled the same way and for the same reason: valuable software tools should not be locked within the programs in which they are used. UPPER.C and WPFILTER.H will come in handy later, when we do other things under the banner "After you say hello . . . ."

Of course, more could be done with WSTOASC. For example, it could be given functions that translate WordStar's control codes to those understood by another word processing program. That way, features like boldface and underlines could be transported easily. WordStar's dot commands could be translated, too; for ROFF and its descendants, ".pa" or ".PA" might be translated into ".bp" as the symbol to begin a new page. Maybe we'll do some of that in the future. But for now WSTOASC is good enough for its purpose: safe and effective WordStar-to-ASCII filtering.

Ordering Information

Eco-C88, Release 3.0 (MS-DOS), $59.95.
Ecosoft, Inc.
6413 North College Avenue
Indianapolis, IN 46220
317/255-6476

The C Library by Kris Jamsa, ISBN 0-07-881110-4, $18.95.
Osborne McGraw-Hill

```
/*
** upper.c -- uppercase a string
*/

upper(s)
char *s;                                    /* pointer to string */
{
    char *p;
    for(p = s; *p; ++p)
        *p = toupper(*p);
    return(s);
}       /* end upper() */
```

Listing 2. UPPER.C—a function to convert a string to uppercase.

Listing 3. WSTOASC.C, version 2.

```
/*
** WSTOASC.C
**
** Version 2.00 -- The Final bow
** By Joseph Katz for "C Notes" in SEXTANT
**
*/

#include <stdio.h>                          /* compiler dependent */
#include <wpfilter.h>              /* to identify WordStar codes */
#include <upper.c>       /* to uppercase filenames for testing */

#define EOF -1                              /* compiler dependent */
#define NULL 0                              /* compiler dependent */
#define FALSE 0                             /* compiler dependent */
#define TRUE 1                              /* compiler dependent */

#define VERSION     "2.00"                    /* program version */

int c;                                                 /* bytes */

int inname, outname;               /* filenames made into strings*/
FILE *input, *output, *fopen();
```


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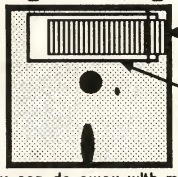

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```
/*
**  banner -- program title page and copyright notice
*/
banner()
{
    printf("WSTOASCI -- WordStar-to-ASCII filter\n");
    printf("Copyright (C), 1986, by JOSEPH KATZ\n");
    printf("For \"C Notes\" in SEXTANT\n");
    printf("Version %s\n\n", VERSION);/* cosmetic doublespace */
}  /* end banner() */

main(argc,argv)                          /* accept command args */
int argc;                                       /* count args */

char *argv[];                           /* array of ptrs to args */

{
    banner();                   /* show the flag no matter what */

/*
**  error trapping begins here and slides into work
*/

/* 1.  correct number of arguments?                              */
    if(argc != 3) {
        printf("Specify input and output filenames\n");
        exit(1);                                    /* error exit */
    }

/* 2.  same name used for input and output files?                */
    inname = upper(argv[1]);            /* uppercase input name */
    outname = upper(argv[2]);           /* uppercase output name */
    if(strcmp(inname, outname) == NULL) {  /* NULL if the same */
        printf("Make input and output names unique\n");
        exit(1);                                    /* error exit */
    }

/* 3.  extant file with same name as output?                     */
    if(fopen(argv[2],"r") != NULL) {  /* name in use by a file */
        printf("Overwrite existing file (Y/N)?  "); /* mercy   */
        if(toupper(getchar()) != 'Y') {     /* 'Y' or 'y' only */
            printf("Terminated by user\n");    /* not a "Y"    */
            exit(1);                                /* error exit */
        }
    }

/* 4. open input if it exists, else quit                         */
    input=fopen(argv[1],"r");                       /* open input */
    if(input==NULL) {                                  /* error? */
        puts("Can't find the input file");
        exit(1);                                    /* error exit */
    }

/* 5. open output for writing--quit if can't do so               */
    output=fopen(argv[2],"w");                     /* open output */
    if(output==NULL) {                            /* can't do it? */
        puts("Can't make the output file");
        fclose(input);                  /* close unneeded files */
        exit(1);                                    /* error exit */
    }

/*
** both files are now open, so begin pumping bytes
*/
    while((c=getc(input))!=EOF) {                  /* flow control */
        c&=0x7F;                            /* unset high order bit */
        if(iswordstar(c)) continue;                /* skip garbage */
        putc(c,output);                       /* keep a good one */
    }
    fclose(input);                              /* close for exit */
    fclose(output);                             /* close for exit */
    exit(0);                                         /* good exit */
}   /* end main() */
/* end of wstoas.c */
```

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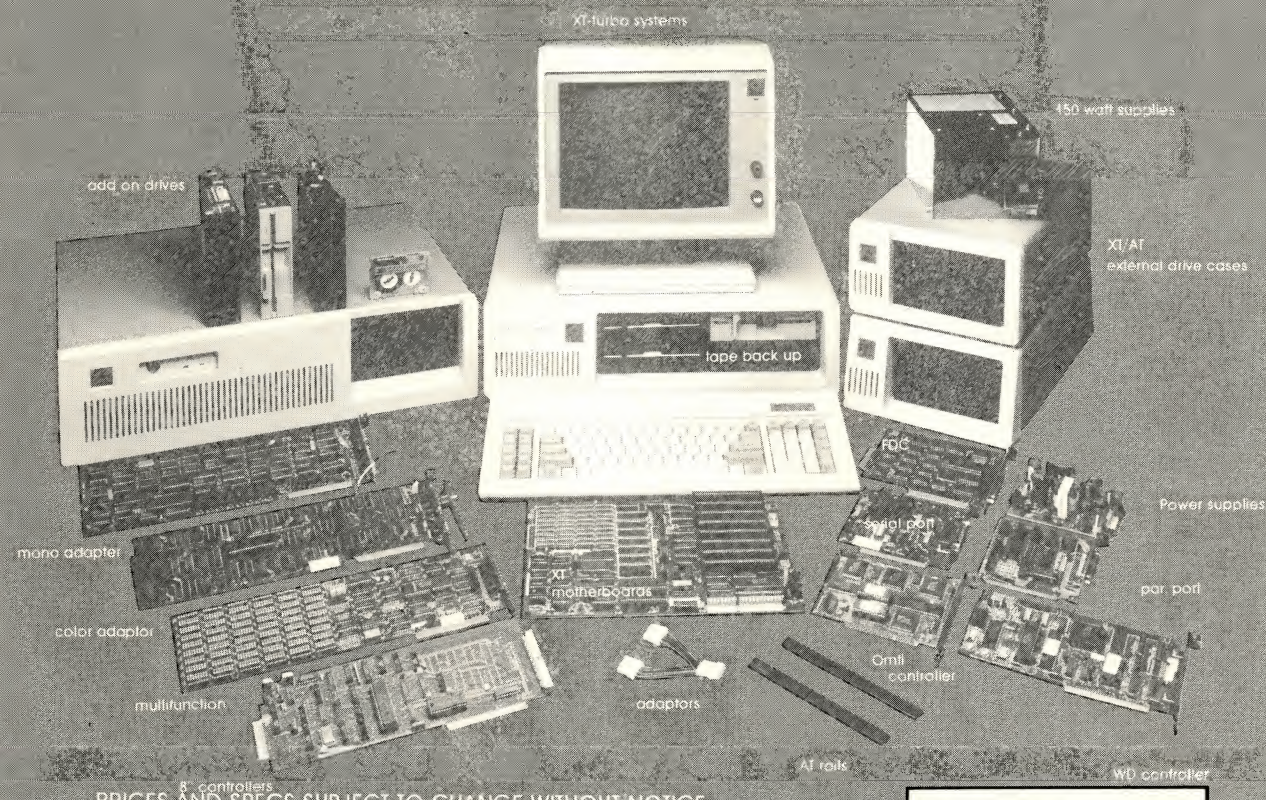

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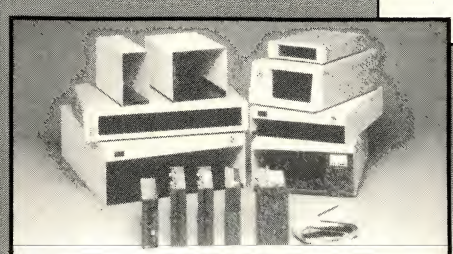

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A minor change to MS-DOS allows the H/Z100 to control four 5¼" disk drives. A minor hardware change allows mixing 40-track and 80-track drives.

William N. Tavolga

Here I am with a new, up-to-date Z100, but its floppy disk capacity is far below that of my old H8.

The ancient H8 was equipped with five drives: one 48-track-per-inch (40-track) and two 96-t.p.i. (80-track) hard-sector drives, one soft-sector 48-t.p.i., and one soft-sector 96-t.p.i. With the Z100 machines, Heath/Zenith permits you to expand only with dinosaur 8" drives, or a super-high-capacity hard disk. The latter goes far beyond my requirements and wallet.

Why not more than two 5¼" drives? Page 6.2 of the Z100 Technical Manual says about the floppy disk controller:

"Up to four 5.25" drives and four 8" drives may be used. (Current software supports only two drives of each type.)"

That observation was made while the Z100's standard operating system was the Zenith Disk Operating System (Z-DOS), Zenith's implementation of version 1 of the Microsoft Disk Operating System (MS-DOS). Had things changed now that we had moved up to version 2 of MS-DOS?

No, version 2 hadn't changed things. Essentially the same statement as above is made on page 1.4 of the version 2 manual, and on page 6.8, we find:

"While the MTR-100 monitor supports four 5.25-inch, four 8-inch, and four Winchester disk drives, MS-DOS version 2 supports two 5.25-inch, two 8-inch, and four Winchester disk drives."

Well, I came to this from the world of the Heath Disk Operating System (HDOS). And to an old HDOS patcher, the restriction to two 5¼" drives was a challenge; it was the first problem I attacked when I received the MS-DOS Programmer's Utility Pack. (If you have moved up to MS-DOS 2 and have not yet purchased the Utility Pack, you should consider it.)

With the Utility Pack in hand, the drive problem can be solved. As we'll see, the Utility Pack provides the necessary source code which must be modified and assembled. We'll need to make a drive cable as well. (And depending on your choice of drives, you may want to add an extra circuit to the drive-controller board.)

Getting a new IO.SYS

The Utility Pack comes with a hefty manual and four disks. Disk one contains several utilities which are new and/or revised from Z-DOS, including a bigger and faster MASM assembler. And the inner recesses of the operating system have been made a bit more accessible by the addition of several new programs such as FLAGS, which lets you change the file attributes (Read-only, System, etc.).

Now I have more than double my previous disk capacity, at relatively low cost.

The other three disks contain the major portion of the source code for IO.SYS, that part of the operating system which interfaces to the input/output (I/O) devices. The IO.SYS source code comes in three versions: one for the Z100-series computers; one for the Z150/160; and a version which enables the Z150/160 computers to emulate the Z100.

All the essential materials are there for you to assemble your own version of IO.SYS! For a system tinkerer, this is a treasure trove.

After some searching and experimentation, I found the appropriate portions of the source code which needed to be changed to make it possible to increase the number of 5¼" floppies to four. I made the changes, assembled the new IO.SYS, and now I have more than double my previous disk capacity, at relatively low cost.

What I propose to do here is to share the secret with you by presenting a series of step-by-step instructions. I will include the directions for assembly of a new IO.SYS. According to the manual, an 8" drive is required for this; but with a little bit of manipulation, it can be done with your two 5¼" floppies.

Do you have the right files?

There is an important precaution to be taken: you have to make sure your copy of the source code is up to date. Even if you received an executable version of IO.SYS that works perfectly, there may be a bug lingering in your .ASM file.

The problem arises because of a bug in Heath/Zenith's original version of the IO.SYS file for MS-DOS 2.13. That bug caused a loss of characters during serial I/O. The bug was corrected, and most registered owners of MS-DOS 2 should have received (gratis) an update disk. (Mine was numbered OS-840-2.)

One might assume that the executable code is the assembled version of the .ASM source code files you have on disk. Unfortunately, the .ASM files don't seem to get updated as frequently as the executable version: you should check your BCHRIO.ASM file to see when it was written.

For instance, with the version of the Programmer's Utility Pack that I received, BCHRIO.ASM has a size of 51,555 bytes and is dated 7-30-84. In this version, BCHRIO still has the bug, even though the executable version I received had been corrected. If you have this version, you're probably going to want to take care of the bug before assembling the BCHRIO module.

Sextant, however, has a newer version. Their BCHRIO.ASM is 55,671 bytes long and is dated 1-25-85. There, the bug has

William N. Tavolga is a senior research scientist at Mote Marine Laboratory in Sarasota, Florida. He enjoys computer building and programming, ham radio, and enology.

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been corrected. If you have that version, you should be able to assemble and use it without any problem.

The bug itself causes problems in two areas. First, output to the PRN: and AUX: is slow; second, you can lose characters during serial I/O.

Rick Schaeffer of Spokane, Washington, patched the code to correct this bug, and *Buss* newsletter published it in its issue #95, September 21, 1984. (See "Patch for Z-DOS 2.13 to Prevent Dropped Characters."). His patch was then passed along to members of the national Heath Users' Group by Pat Swayne, HUG's software engineer. (See *REMark*, December 1984, "Some Fixes for MS-DOS 2.13.") Apparently, it was included in the executable version almost immediately thereafter.

If you have an uncorrected version, you can check either the *Buss* or the *REMark* article to see what needs to be done. Both these articles are written in terms of patching the executable code by means of DEBUG or some other program that lets you modify the executable code.

If you have the older version of the source code and the newer version of the object code, as I do, you may decide to check out Schaeffer's patch in order to change BCHRIO.ASM. Remember, though, that it is a fairly large file, and it may exceed the size limitations of some editing programs, such as PIE from The Software Toolworks.

Alternatively, you may wish to get an updated version of the Programmer's Utility Pack. You must return the original disks; there is a charge of $24 for the first disk, and $12 for each additional disk, plus postage. Specify MS-DOS 2, because the Utility Pack is now also available for MS-DOS 3.

Using both 48- and 96-t.p.i. drives

After modifying IO.SYS to handle additional 5¼" drives, my second task was to get the best use possible out of my 96-t.p.i. Tandon drives, left over from the old H8. The Heath/Zenith manuals mention the use of 96-t.p.i. drives only in passing.

To switch the *entire* system over to 96 t.p.i. is simplicity itself.

On the floppy-disk controller board is a DIP switch, and the zero section (rightmost) is normally set down to ON. This drops pin 6 of chip U31 to ground. If you set that switch section to OFF, the pin goes high to +5 volts, and all your drives are now seen as 96-t.p.i.

Your system will then read, but not write, 48-t.p.i. formatted disks. You can even create a new 96-t.p.i. system disk; just format and copy from a 48-t.p.i. system disk in a 96-t.p.i. drive to a new disk in a second drive.

Simply changing the DIP switch, then, seems like a great way to double your disk capacity. However, it produces a nonstandard configuration that may be troublesome. For one thing, if you should switch back to the 48-t.p.i. configuration, any data on your 96-t.p.i. disks is unavailable. There is also, as we'll see, a problem in the FORMAT program that may give you difficulties.

However, there is a way to have both 96- and 48-t.p.i. drives.

Getting the drives to work with IO.SYS

The entire procedure can be broken down into six major stages:

1) Copy necessary files and prepare three disks.
2) Edit and modify the IO.SYS source code; create a MKBIOS.BAT file containing all the commands you need to assemble a new IO.SYS file.
3) Assemble the new IO.SYS file.
4) Install the new IO.SYS.
5) Make a suitable cable and attach the additional drives.
6) Make some circuit changes if you wish to mix 48- and 96-t.p.i. disk drives.

Copy files and prepare disks

Format three disks and label them: SOURCE, NEWSYS, and MKBIOS.

Onto the disk labelled SOURCE, copy files from the two PUP distribution disks labelled Z100 BIOS Sources. (The only files you won't need are BIOS.DQ, DEFBIOS.ASM, and ANSICON.ASM.) At least this one disk will have to be formatted with the /9 switch (nine sectors per track). The default (eight sectors per track) won't provide enough storage space for all the files you'll need.

When you format the NEWSYS disk, use the /S switch to transfer your current operating system to it. You may use either the original MS-DOS 2 or an updated version.

You will later replace the IO.SYS on this disk with your new one. So, you need to remove from the current IO.SYS all the flags that protect it from modification (the System, Hidden, and Read-only flags). Place the NEWSYS disk in A: and the MS-DOS Utilities disk in B:, and give the command:

B:FLAGS IO.SYS<RETURN>

At this time, you may want to transfer appropriate standard files, e.g., ALTCHAR.SYS. Also, you may later want DEBUG on the NEWSYS disk. Use the latest version from your MS-DOS 2 Disk II, subdirectory DEVEL.

Onto the disk labelled MKBIOS, copy MASM.EXE from your MS-DOS 2 Utilities disk, and LINK.EXE and EXE2BIN.EXE from MS-DOS 2 Disk II, subdirectory DEVEL.

From the SOURCE disk, copy the files DEFDSK.ASM and BDSKTB.ASM, renaming them DEFDSK.NEW and BDSKTB.NEW. Also copy BIOSL over to the new MKBIOS disk.

Edit source code; create MKBIOS.BAT

Place the MKBIOS disk in B:, and a disk with your favorite text editor in A:. My own preference is for a simple editing

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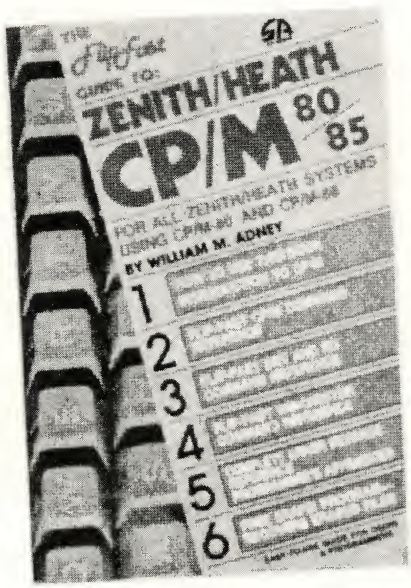

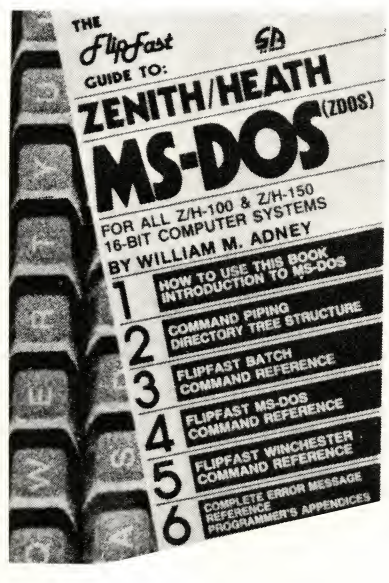
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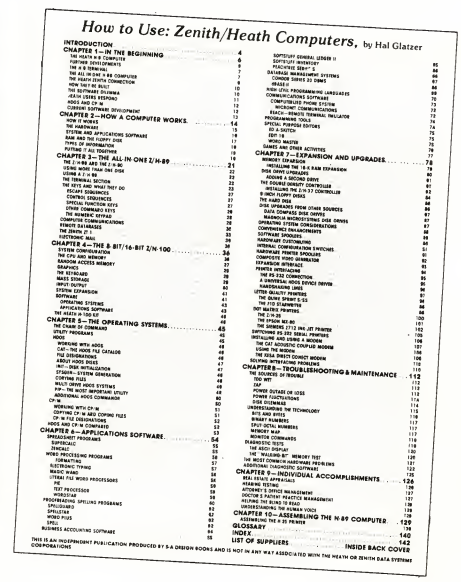

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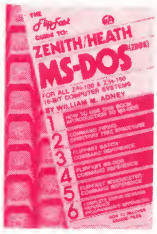

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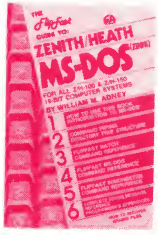

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program like The Software Toolworks' PIE, or the ZEDITOR that comes as an added attraction on the MS-DOS Utilities disk. You will now edit the DEFDSK.NEW and BDSKTB.NEW files.

Here, you will have a choice to make. If you follow my instructions, you will eliminate the support for two 8" drives and substitute two additional 5¼" drives, while leaving the code for the hard disk intact.

Actually, the hardware permits you to have up to four 5¼" and four 8" drives. But don't get too greedy and put in too many changes, because there is a domino effect. If you later try to put in any patches of the executable code, you will find you have moved their expected locations off into never-never land. As it is, the changes in Listing 1 will move most locations forward by eight bytes.

First, you must inform the software that you will have more than two 5¼" drives.

Load the file DEFDSK.NEW into your editor. After the 40th line, locate the definitions of MAXDSK as given in the top portion of Listing 1.

Change the lines as shown in the lower portion of Listing 1.

This will eliminate the 8" drives without changing other code locations too much.

```
MAXDSK  EQU     15              ; Maximum number of disks
MAXDSK5 EQU     2               ; Maximum 5 inch drives (0-1)
MAXDSK8 EQU     4               ; Maximum 8 inch drives (2-3)
MAXDSKW EQU     8               ; Maximum winchester drive (4-7)
Change the lines as follows:
MAXDSK  EQU     15              ; Maximum number of disks
MAXDSK5 EQU     4               ; Maximum 5 inch drives (0-3)
MAXDSKW EQU     8               ; Maximum winchester drive (4-7)
MAXDSK8 EQU     8               ; 8 inch drives not available
```

Listing 1. Four lines from the DEFDSK file, before and after editing.

```
Following is a list of changes according to line number:
Line #        Old code                                  New code
174   ; DISK2 - 8" unit 0                  ; DISK2 - 5QTR" unit 2
181     DB     DSK_TZ2078                    DB     DSK_TZ2075
187     DB     DSK_FDS+DSK_FDC+DSK_FRS       DB    DSK_FDS+DSK_FDC+DSK_FSL
189     DB     CONDSEN+0+CONDS8+CONPC        DB    CONDSEN+2+CONPC
201     DB     FDCSEK+FDFHLB+FDFVRF+FDFS30   DB    FDCSEK+FDFHLB+FDFS30
205     DB     77                            DB     80
211     DB     1024                          DB     512
213     DB     1                             DB     6437
215     DB     1                             DB     6437
235   ; DISK3 - 8" unit 1                  ; DISK3 - 5QTR" unit 3
242     DB     DSK_TZ2078                    DB     DSK_TZ2075
248     DB     DSK_FDS+DSK_FDC+DSK_FRS       DB     DSK_FDS+DSK_FDC+DSK_FSL
250     DB     CONDSEN+0+CONDS8+CONPC        DB     CONDSEN+3+CONPC
262     DB     FDCSEK+FDFHLB+FDFVRF+FDFS30   DB     FDCSEK+FDFHLB+FDFS30
266     DB     77                            DB     80
272     DB     1024                          DB     512
274     DB     1                             DB     6437
276     DB     1                             DB     6437
```

Table 1. Changes to the file BDSKTB, listed by line number.

The MAXDSK values are actually a table of disk-drive assignments, rather than absolute values. There are probably several ways of making the change, but this is all you need to do with the DEFDSK.NEW file. Save it back to its disk.

This change, by the way, keeps the total code size almost the same. Should you someday wish to patch the runnable code, patch locations will be offset by only eight bytes, as you will see later.

Next, load the file BDSKTB.NEW into your editor and make the changes indicated in Table 1. As you examine the BDSKTB.NEW file, you will see the code for 5¼" Unit 0 (DISK0) and 5¼" Unit 1 (DISK1). When you come to the section for 8" Unit 0 (DISK2), change that to 5¼" Unit 2.

Keep all the references to "DISK2" intact; what we need to do is change the code in DISK2's section to match that in the previous section. (The differences are on 18 lines scattered through about 100 lines of code. Line number references are given in Table 1.) Similarly, change the code in the section for 8" Unit 1 (DISK3), making it 5¼" Unit 3.

Check your work carefully. A seemingly minor error here can abort your assembly. Or worse, it can crash your system, leaving your disks writhing in agony. Save your work back onto the MKBIOS disk.

Examine the file BIOSL that you copied from the SOURCE disk. This is the list of .OBJ files LINK will need in order to produce an executable IO.SYS file. Checking it, you'll see that it squares with MKBIOS.BAT's references to files to be assembled by MASM. (See below.) And you'll see that the LINK program is directed to use it (near the end of the .BAT file).

Unless you can think of some need for a listing file, you can delete the fourth (last) line of BIOSL:

```
BIOS /MAP;
```

Then add a terminating semicolon to the third line, thus:

```
BIOS;
```

Now you will create a MKBIOS.BAT file, as in Listing 2. I recommend that you assemble the new IO.SYS in modules, so that you can catch errors along the way. This is why the file contains a "pause" instruction after each .OBJ file is generated. If there are errors, you can abort (CTRL-C); if not, you can hit RETURN and continue to the next module.

There is not enough room on two 5¼" disks to use the MAKEBIOS or BIOS.DO programs as supplied with MS-DOS, so it is necessary to copy over only those .ASM files that are needed for the assembly of a particular .OBJ file.

Each of the sections of my MKBIOS.BAT file—except the last—will produce a single .OBJ file. You will end up with a full dozen of these. The last section copies two additional .OBJ files from your source disk, and invokes the LINK program. Then the EXE2BIN program is called to

transform the BIOS.EXE (relocatable) to a BIOS.BIN (fixed location in memory) program.

Be sure that the EXEBIOS.DAT file is on your SOURCE disk. During the assembly procedures, this file will provide a "fix-up." All it contains is the number 40; this tells EXE2BIN the absolute segment address (hexadecimal) at which the finished file is to be located.

Finally, BIOS.BIN will be renamed to BIOS.SYS.

Assemble new IO.SYS file

After you have created the MKBIOS.BAT file given in Listing 2, save it on your MKBIOS disk. Then place the MKBIOS disk in drive A: and the SOURCE disk in B:. Run MKBIOS.BAT and watch for assembly errors at each stage.

The most frequent assembly error is the inability to load an .ASM file. Examine the MKBIOS.BAT file with your editor; most likely, you omitted or misspelled one of the necessary .ASM labels. Fix it, restore the disks, and rerun the program.

Be patient; even a flawless run may take about half an hour to complete. Your final product will be a file labelled BIOS.SYS.

Near the end, when the LINK operation is completed, an error will be flagged: no stack segment. Pay no attention. It is not necessary to have a stack segment declared when you convert an .EXE program to a .BIN type.

Install the new IO.SYS

Place your NEWSYS disk in B:, and copy the new BIOS.SYS file to it, renaming BIOS.SYS to IO.SYS. First, though, you should delete the old IO.SYS. (Did you remember to use FLAGS?)

```
DEL B:IO.SYS
COPY BIOS.SYS B:IO.SYS
```

(IO.SYS must reside as the first file on your disk, or else you will get a "No System" error at boot-up.)

Now transfer the NEWSYS disk to drive A:.

As an aside, this may be a good time to consider whether there's any other patching work you may want to perform on IO.SYS. If you patch the machine-readable code (with DEBUG or some other program), just remember that code locations will have been moved up eight bytes by the changes described here.

Attaching the drives

Are we ready for the moment of truth? Not quite. You should set up your hardware first. After all, that's what all this is about.

You need a new 34-wire ribbon cable with a single female pin connector, and four edge card connectors. I made my own with connectors from Radio Shack. Purchase of ready-made cables like this one may be difficult.

The entire cable should be more than three feet in length. The first two edge connectors (nearest the pin connector) would be for the internal drives. Make certain you give yourself enough slack between connectors; the exact distances vary depending upon whether your machine is an all-in-one or a low-profile, and if the disk drives are full- or half-size.

The arrangement of your new drives will determine how you attach the remaining two edge connectors. You should not have any problems with these ribbon connectors if you are very careful; use even, gradual pressure (as with a large vise) to force the connector onto the cable.

Look closely before applying pressure to see that each of the 34 wires sits over a pair of metal prongs. Generally, if the prongs at each end are set properly, the others will fit in. Make sure also that the sockets point in the right directions.

Note the position of the colored wire along one edge of the ribbon cable. When plugged into the controller card, this wire should be on the right (as viewed from the front of the machine). With the drive facing you and in its horizontal position (as it would be in the Z100), the edge connector should be plugged in so that the marked wire is on the right.

Before installing your connectors, put the cable in place to give you an idea of where the connectors should be attached and how they should be oriented. A couple of "rehearsals" can often save a lot of grief later.

The cable going out to the extra drives can be dressed along the right side of the plug-in board frame, and the top cover has enough play to let the cable through. You may want to feed it through one of the unused port apertures, but you will have to enlarge the opening because the connectors will not make it otherwise. (I found out.)

It is probably not a good idea to try to squeeze more than two drives into your cabinet—although the new half-height drives make it tempting. The heat and load on the internal power supply may be damaging. It is best to have an outboard unit with a separate power supply for your additional drives. You are not required to add both at once. The system runs nicely with three drives.

Your additional drives normally would be configured as C: and D:, although there is no law that says so. You can make your external drives A: and B: if you wish. All you have to do is set the jumpers in your disk drive appropriately.

You must, however, observe the rule that only one resistor pack should be installed in the daisy chain, preferably in the last drive on the cable.

In my setup, I've left the resistor pack in internal drive A:, which is the first unit in the daisy chain. I have used this system for almost a year and have had no problems with this arrangement.

The advantage of leaving the resistor pack in the internal drive is that if you want to disconnect the external drives,

```
DEL *.ASM
COPY B:BIOS.ASM
COPY B:VER.ASM
COPY B:PARMS.ASM
COPY B:DEFASCII.ASM
COPY B:DEFCONFG.ASM
COPY B:DEFMTR.ASM
COPY B:DEF8259A.ASM
MASM BIOS;
PAUSE
DEL BIOS.ASM
COPY B:PBE.ASM
COPY B:DEFCHR.ASM
COPY B:DEFDEV.ASM
COPY DEFDSK.NEW DEFDSK.ASM
COPY B:DEFZ2*.ASM
MASM PBE;
PAUSE
DEL PBE.ASM
COPY B:BDEV.ASM
COPY B:MACLIB.ASM
COPY B:DEFDOSI.ASM
MASM BDEV;
PAUSE
DEL BDEV.ASM
COPY B:BBLKDEV.ASM
COPY B:DEFFMT.ASM
COPY B:DEFSBC.ASM
MASM BBLKDEV;
PAUSE
DEL BBLKDEV.ASM
COPY B:BCHRDEV.ASM
COPY B:DEF6821.ASM
COPY B:DEFIPAGE.ASM
MASM BCHRDEV;
PAUSE
DEL BCHRDEV.ASM
DEL DEF6821.ASM
COPY B:BCLOCK.ASM
COPY B:DEF8253.ASM
COPY B:DEFEVN.ASM
MASM BCLOCK;
PAUSE
DEL BCLOCK.ASM
COPY B:BDSK.ASM
COPY B:DSK.ASM
COPY BDSKTB.NEW BDSKTB.ASM
MASM BDSK;
PAUSE
DEL BDSK.ASM
DEL DSK.ASM
DEL BDSKTB.ASM
COPY B:BDSK207.ASM
COPY B:DSK207.ASM
MASM BDSK207;
PAUSE
DEL BDSK207.ASM
DEL DSK207.ASM
COPY B:BDSK217.ASM
COPY B:DSK217.ASM
MASM BDSK217;
PAUSE
DEL BDSK217.ASM
DEL DSK217.ASM
COPY B:BCHR.ASM
COPY B:DEF68*.ASM
COPY B:DEFEP2.ASM
COPY B:BCHRIO.ASM
MASM BCHR;
PAUSE
DEL BCHR.ASM
DEL BCHRIO.ASM
COPY B:BFL.ASM
COPY B:DEFMS.ASM
MASM BFL;
PAUSE
DEL BFL.ASM
COPY B:BINIT.ASM
COPY B:DEFDIR.ASM
MASM BINIT;
PAUSE
DEL *.ASM
COPY B:SYS*.OBJ
LINK @BIOSL
EXE2BIN BIOS<B:EXEBIOS.DAT
REN BIOS.BIN BIOS.SYS
```

Listing 2. MKBIOS.BAT allows the new BIOS to be generated using two 5¼" disks.

you just pull off the ribbon connectors; you don't have to go digging into the nether regions of the main unit to insert a resistor pack. The main thing to remember is that one and only one resistor pack in the series is permissible.

A side effect of my modification to IO.SYS is that if you use a RAM-disk program such as MDISK.DVD, the RAM drive becomes G: instead of I:. If you add a hard disk, it becomes drives E: and F:. (Although if you have a hard disk, I can't see why you'd need to add the floppies.)

I have tried both 48- and 96-t.p.i. drives, and unless you make some hardware changes (discussed below), the 96-t.p.i. drive acts just like a 48. To use a single-sided drive, the disks used must be formatted with the /M switch. (If you have single-sided 8" drives, the /A switch is for single-density, 77-t.p.i.) A two-sided drive, though, will recognize a single-sided disk automatically.

This is a great way to use your leftover one-sided disk drives and your old disks. Each will give you an addition of about 160K disk space. (If you have the older Seimens or Wangco drives, you have a choice between "HS" and "HM" jumpers: the HS configuration should be used.)

Test it

All done? OK. Install your newly made NEWSYS disk, and do a CTRL-RESET. As the boot proceeds, the lights on each of your drives (including C: and D:) will go on briefly. Without inserting a disk in your new drive, try to call up its directory. You should get an error response as follows:

```
Not ready error reading drive C
Abort, Retry, Ignore?
```

This shows that the system has at least recognized the drive. If you put a formatted disk into it, it will respond to all commands. You can format disks in the new drives, and you can even boot from them.

If your initial message is:

```
Place disk C in drive A:.
Press RETURN when ready.
```

then the drive has not been properly logged in.

That can be caused by a peculiarity of the drive itself. Some brands, notably Tandon, require that a disk be inserted and the door closed before booting up. Try this and reboot.

I have found failure to recognize the existence of the drive more apt to occur with older 96-t.p.i. Tandon drives, and upon a truly cold boot rather than just a CTRL-RESET.

If your external drives are switched on at the same time as the main computer, the external drives' power supply may require a slightly longer warmup time. Consequently, it may be good practice to switch that one on a bit ahead of time. Or, if you have the Z100's auto-boot in effect, delay inserting the system disk at least until the "Device Error" appears. Personally, I prefer not to use the auto-boot configuration anyway—even solid-state devices need warmup time.

The most likely sources of problems are:

a) incorrectly configured disk drives
Remedy: Check the configuring jumpers on each drive.

b) an extra resistor pack
Remedy: Take it out; only one can be installed.

c) cable connector is badly attached to the ribbon cable
Remedy: Remove the suspected one, and try re-installing it. Most likely, though, it will have to be replaced, since removal may cause damage. These things are tricky.

d) no power to the disk drives
Remedy: Plug in the line cord and turn on the switch!

CONFIGURing the new system

Once you are sure it all works, you can use MS-DOS's SYS.COM utility to transfer your new system to your old system disks.

Before you do that, however, run the CONFIGUR program to configure the system to your printer and other devices.

Also, you will have to set each drive's seek time—the time that the drives take to step between tracks. Notice that CONFIGUR's step-rate menu for drives C: and D: allows you to choose as short a seek time as 3 milliseconds. Unless you are certain of your drives, however, the minimum value in practice is about 6 ms.

The transfer accomplished by the SYS.COM utility will automatically set the protective flags on IO.SYS, but it is a good idea to go back to your NEWSYS disk and restore them there, too. Use the FLAGS program, and restore flags with the command: FLAGS IO.SYS RASH. This will make it Read-only, set the Archive bit (for use with the BACKUP utility), mark it as a System file, and make it Hidden from an ordinary directory display.

For the record, you should move the MKBIOS.BAT, DEFDSK.NEW, and BDSKTB.NEW files to the NEWSYS disk and put it in safe storage in case you should need to go back and find out what you did. You may even want to save the MKBIOS disk with all the .OBJ files as well. Keep the SOURCE disk intact with the original copies of the source code.

Never make any changes to the original distribution disks!

Do you have a Z150?

The IO.SYS for the Z150 is already set up for four 5¼" floppies. Attachment of two additional drives is simplicity itself. All you need for hardware is a pair of external drives with power supply, and a standard 34-wire flat cable with two-edge connectors at one end and a female connector at the other.

The Z150 controller card has a second 34-pin header just for this purpose. The

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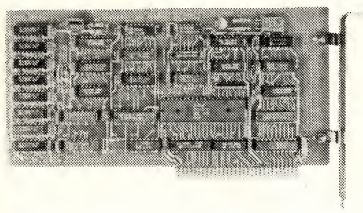

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new drives must be configured as 0 and 1 (as if they were A: and B:), and one must have a resistor pack. DIP switch #1 on the CPU board should be set for four drives. (See your Operations Manual, Chapter 2, "Hardware.") The new drives will become C: and D:. However, only 48-t.p.i. drives are supported—at least I have not yet found a way to change that.

Some of you have the Z319 board which allows a Z150 to emulate the Z100. In your handy Programmer's Pack, there is a disk marked "Z100 PC/Z100 Mode" containing the Z100-emulating version of IO.SYS.

I have not personally tried this, but the MAXDSK changes shown in Listing 1 could be made in the "Z100 PC/Z100 Mode" DEFDSK.ASM file. The equivalent of BDSKTB.ASM is the DSKFUNC.ASM file; you need not make any changes there, since the provision for the four floppies is already there.

If you have a Z150 with a Z319 board and are feeling adventurous, all you need to do is make the small changes in DEFDSK.ASM, and re-assemble the whole IO.SYS. Good luck.

Or an emulator?

Emulators are another matter.

HUG's ZPC software lets a Z100 emulate an IBM Personal Computer. (It was written by Pat Swayne, and he described it in the November and December 1985 issues of *REMark*.) ZPC uses your original system files; the PC mode supports the additional drives in either 96-t.p.i. or 48-t.p.i. format.

The emulator board from Gemini Technology, however, goes catatonic if the extra drives are attached and turned on at the same time the computer is powered up. Otherwise, it ignores the extras completely. Perhaps subsequent updates will change this. This is clearly a limitation in the Gemini board, since IBM's PC-DOS supports the additional drives (as with the Z150).

(I haven't yet been able to test my changes with the emulator board from U.C.I. Corporation.)

Getting the Z100 to recognize 96-t.p.i. drives

To get your Z100 to recognize 96-t.p.i. drives, we have to go to the floppy-disk controller board.

The settings on the DIP switch are evidently read frequently by the software to determine the disk-drive status. As mentioned above, if you set the zero section of this switch to the up position, all the drives will be seen as 96-t.p.i. types. In essence, U31 (pin 6) reads that switch section in order to set the value of bit 3 in the status port of the floppy-disk controller.

There is a pull-up resistor and a +5 volt supply on U31 pin 6; so when the switch is up, the signal to the pin is high. The down position grounds the pin to zero. This is the official "normal" 48-t.p.i. position. To add some confusion, even though this position is grounded, it's labelled ON.

Coincidentally, and conveniently, when a drive is selected (through U11 to the ribbon-cable connector), one of the four drive-selector lines goes low. These are pins 10, 6, 12, and 8 of U11 (a chip composed of six open-collector buffers).

These drive-selector lines go, respectively, to pins 10 (drive 0), 12 (drive 1), 14 (drive 2), and 6 (drive 3), of the edge connector for the ribbon cable. From this, it is clear that the hardware will support up to four 5¼" floppies.

The facts above were the basis for a modification by Michael Rice originally described in *H-Scoop*. (See page 1 of the May 1983 issue.) You set your DIP switch 0 up (OFF); i.e., the 96-t.p.i. format is selected. A jumper wire is installed between pin 10 of U11 (the drive-0 selector line) and the high end of the DIP switch section 0 (at pin 6 on U31).

When drive 0 (A:) is selected, the status line goes low, and the controller is informed that it is dealing with a 48-t.p.i. drive. When drive 1 (B:) is selected, the default status remains as set by the DIP switch. In this way, you make your A: drive 48-t.p.i., and B: is 96-t.p.i.

Mixing 48- and 96-t.p.i. drives

With our four-drive modification, you have a problem if, as I did, you decide on

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Circle #144 on Reader Service Card

two 48s and two 96s. The 96s are no problem, since they will be configured by the DIP switch. But the jumper lines from the two 48s have to be isolated from each other. This means adding another integrated-circuit (IC) chip, preferably an open-collector buffer like U11. This is an easily available chip: SN7417. Let's call it U11A in our circuit.

The schematic for this modification is shown in Figure 1.

Physically, the installation was quite easy. Basically, I added a socket for the new IC, and connected it to the original circuit by five jumpers. The original circuit itself was left intact; nothing was removed or cut.

I recommend using a 14-pin IC socket rather than wiring directly to the chip; then you can insert the SN7417 after all jumpers are in. The advantage to this is that the circuit can be restored to normal operation simply by removing U11A and resetting the DIP switch.

There is a convenient spot for the 14-pin socket on the lower right corner of the controller board. Bend the socket pins outward and up at an angle, and the socket can be attached by a small screw or some epoxy glue. There is an unused hole right at that corner, and you can string your wires through it to the back of the board.

Use a fine, solid hook-up wire (#30 size does well), and tack the wire to the appropriate pins with a very small soldering iron and low heat. Careful here—not too much heat!

Carefully check the pins you want to connect to. Remember that in the standard DIP configuration, pin 1 is to the left of the notch on the chip as seen from above, and the count proceeds down and counterclockwise.

Consult Figure 2 for the placement of the new IC and the others involved. The view shown is from the component side. Obviously, if you look from beneath, the whole thing will be reversed.

Once the socket is in place, install the following jumpers:

1) Pin 14 of the U11A socket to the left-hand end of R25 (the lowest of the bank of horizontally-arranged resistors just above the location of your new socket). This is your +5 volt supply.

2) Pin 7 through the corner hole and to the wide ground bus along the periphery of the solder side of the card. This is the supply ground.

3) Pin 1 through the corner hole to pin 10 of U11. This routes the select signal for drive 0 to the buffer in U11A. U11 is located just below the edge connector, in the upper right part of the controller card.

4) Pin 3 through the corner hole to pin 6 of U11. This routes the select signal for drive 1 to the buffer in U11A.

5) Pin 4 is jumpered to pin 2, and from there through the corner hole to pin 6 of U31. This line delivers the grounding signal to the disk status byte.

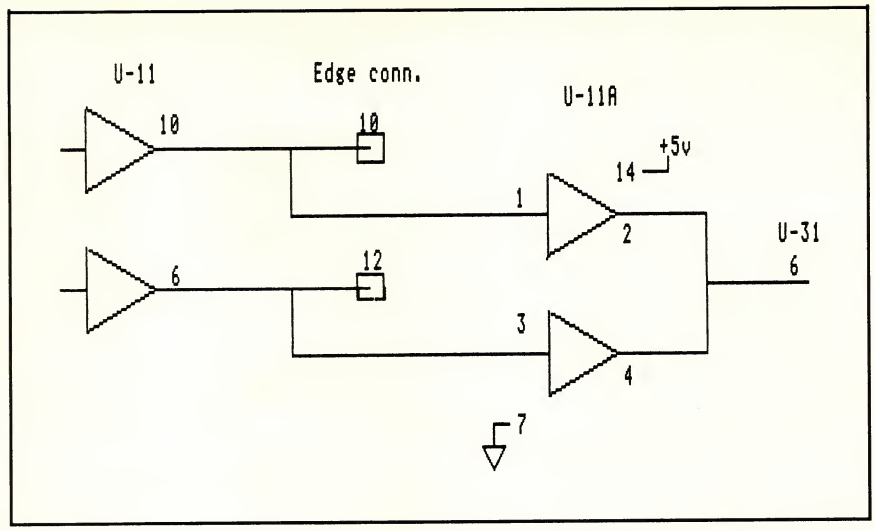

Figure 1. Schematic diagram of the interconnection between chips U11 and U11A.

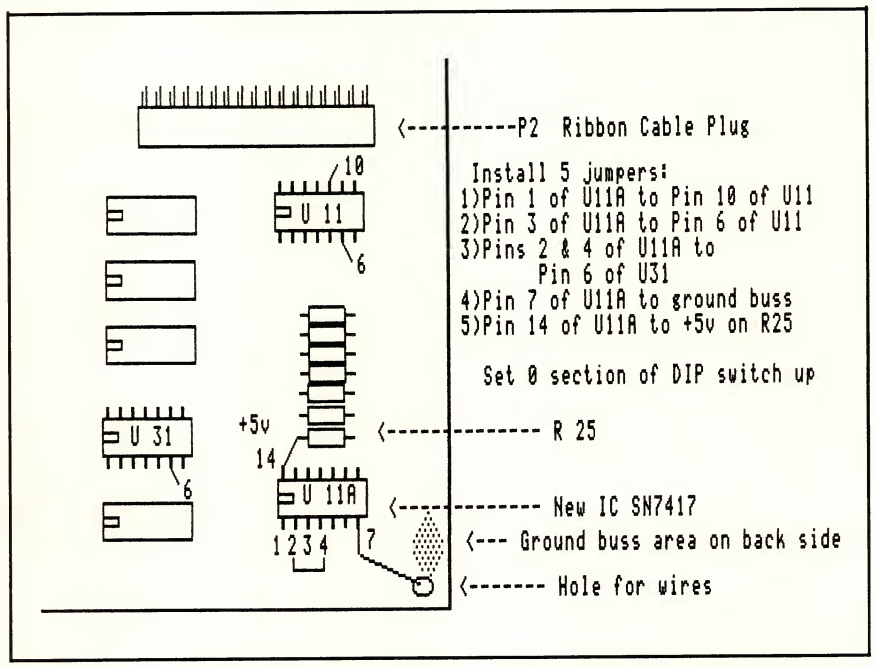
<----------P2 Ribbon Cable Plug
Install 5 jumpers:
1)Pin 1 of U11A to Pin 10 of U11
2)Pin 3 of U11A to Pin 6 of U11
3)Pins 2 & 4 of U11A to
Pin 6 of U31
4)Pin 7 of U11A to ground buss
5)Pin 14 of U11A to +5v on R25
Set 0 section of DIP switch up
10
U 11
6
U 31
6
+5v
14
<---------- R 25
U 11A
1 2 3 4
7
<---------- New IC SN7417
<--- Ground buss area on back side
<------- Hole for wires

Figure 2. A component-side view of the right-hand portion of the floppy-disk controller board indicating installation of U11A.

Now check your connections carefully. Inspect with a magnifying glass to make sure there are no solder bridges, and count the pins again. There is no shame involved in re-checking your work; even experienced technicians make miskates.

Once completed, and the controller card re-installed, the C: and D: drives should light up briefly during boot-up, as before. As noted above, check to see if the disks have been logged into the system. For some brands of drives, you may have to insert a disk, close the door, and reboot.

How can you tell if these drives are configured for 96-t.p.i.? Insert a regular, formatted 48-t.p.i. disk with some files on it. You will find the disk can be read and its directory examined. But if you try to write to it, an error message will appear to the effect that the disk is write-protected. If this happens, you are on the right track.

Now you are ready to format a 96-t.p.i. disk (80 tracks per side).

Formatting a 96-t.p.i disk in a 96-t.p.i. drive

Unfortunately, there is a strange reluctance on the part of the FORMAT program to do this. The problems were encountered by Arthur Seebach, and described and resolved in his letter published in *Buss* #96 (September 1984). I can confirm his observations on the curious behavior of FORMAT.

If you put a new, unformatted disk in a 96-t.p.i. drive, say C:, and your system disk in A:, the FORMAT program will either report a seek failure, or hang up completely, requiring a re-boot.

The procedure that works is as follows:

a) First, format your disk normally in a

48-t.p.i. drive (say, B:). If you listen carefully, you can count 40 clicks.
b) Insert this disk into the 96-t.p.i. drive (say, C:).
c) Change the default drive to C: by typing C:<RETURN>
d) Assuming your system disk is in A:, type A:FORMAT C:/9/V

Setting the switch for nine sectors per track is optional, and will give you 712K instead of the 624K that you would get with the default eight sectors per track. I strongly recommend using the verify (/V) switch just to make sure MS-DOS writes things properly to disk.

Count the clicks as it is formatting, and you should go to 80. If you are lucky, the disk will format without error.
e) If you get a format failure in d) then CTRL-C out of the program, and do it again.

Sometimes it requires two tries, but if your "click count" goes substantially above 40, it means that the 96-t.p.i. modification was successful. So keep trying. (The use of good-quality disks is important; I have found that some bargain, bulk-purchase disks will not work.)

In my own case, I use these super-size floppies just for data storage, but it is also possible to make 96-t.p.i. bootable system disks.

To do so, insert your 96-t.p.i. formatted disk in C:. Then, from your system disk in A:, just run the following command lines:

```
SYS C:
COPY COMMAND.COM C:
```

This will result in a bootable disk. If you put FORMAT.COM on this disk, you can now use this disk to format other 96-t.p.i. disks in the standard way, but you must first re-boot from a 96-t.p.i. drive.

I have had no problems in booting up from these new drives. If autoboot is enabled, just hit the DELETE key right after CTRL-RESET. Press "B" (for Boot), and "2" (for drive C:). As a matter of fact, you can boot up with a 48-t.p.i. disk in a 96-t.p.i. drive.

If you have two 96-t.p.i. drives, then your first 96-t.p.i. formatted disk can serve as a "seed." Put it into drive D: and copy FORMAT.COM to it. Then make D: your default drive. You can format any number of new 96-t.p.i. disks with the command:

```
FORMAT C:/9
```

Occasionally, you may experience a format failure, especially with a new blank disk. Just run it again. Or you can "preformat" new disks in a 48-t.p.i. drive. Then reformat in the 96-t.p.i. drive.

Assuming your D: disk has a system on it, you can create bootable system disks from drive D: in the standard fashion:

```
FORMAT C:/9/S
```

By the way, do not use MS-DOS's DISKCOPY utility with 96-t.p.i. drives—it will crash. Furthermore, it is probably a good idea to use the verify switch (/V) every time you run FORMAT and COPY programs.

It works!

At any rate, I now have:
a) an additional space of almost 1.5 megabytes available using disk drives from my old, semi-retired H8;
b) a few more grey hairs; and
c) a better understanding of the I/O system of MS-DOS.

The value of the new expanded disk system is especially evident if you use a compiler. The C86 C compiler, for example, is a real disk guzzler. With two "normal" drives, the compiler programs (four of them) take up most of your A: disk, while the needed library files and LINK program virtually fill the B: disk. The compiler uses temporary disk space as well. All this leaves little room for a text editor, necessary housekeeping files, and your C source code.

Now, all *that* can go on a 712K disk in C: drive—along with, for instance, all the ZGRAPH files of graphics routines to be used with the C86 compiler. My system disk in A: now has plenty of elbow room, and all my source-code files can go on a separate disk—even another super disk in D:.

A similar arrangement could be made with a Pascal or BASIC compiler, whose libraries and supporting files are quite bulky. Some types of Pascal are especially insidious since the compiler can generate a large p-code file; it's erased, but it temporarily occupies a significant chunk of disk space.

As a disclaimer, I must warn you that any of the above changes, especially to the hardware, may void warranties. You will be doing all this at your own risk. Don't use disks that are not backed up.

All I can tell you is that after a week's worth of evenings, I got this to work, and I am delighted.

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The Eight-Bit World

Walter J. Janowski

VDO editor

Modem programs

Write-Hand Man—update

GEnie system—update

From the mailbag

Gripes

Winding down

This is the third installment of "The Eight-Bit World," and the first one in which I'll be able to consider some reader response. Publishing schedules being what they are, this column is being written shortly after the first column appeared in print; so bear with me if you've written and it takes a while for a response.

This time, I'll include another chapter in my search for the perfect text editor, I'll update a few subjects I've touched upon in the past, and there'll be a few other goodies as well. So, without further ado, let's get started.

VDO editor

In my continuing search for the best text editor for the least money, I've been frustrated for some time. My favorite editor has always been PIE, from The Software Toolworks. I have it for the Heath Disk Operating System (HDOS), but I never got a copy for CP/M.

PIE is certainly priced about as reasonably as any product could be ($29.95 for the PIE editor, $39.95 for the TEXT print formatter); I considered it a challenge to find a cheaper CP/M editor, free if possible.

While browsing the libraries of GEnie recently, I came across a pretty close contender. Its name is VDO, Video-Oriented Editor, and it's the nearest thing to perfect I've come across yet. VDO is written and copyrighted by James H. Whorton, and while it is not in the public domain, it has been released for non-profit distribution and use.

VDO is a general-purpose ASCII full-screen editor, and comes with an installation utility to configure it to various terminals (including the H19). Its most impressive feature is its size. VDO features a fully functional editor not unlike WordStar, and manages to pack it all into only 7 kilobytes (!) of memory.

VDO includes full cursor control using WordStar-like control characters. (Sorry, no arrow keys.) It has all the normal block-manipulation functions, search and replace, and on-line help screens. It's unbelievable how all that is squeezed into such a little space.

Most control-key functions and cursor controls are compatible with those of WordStar; so if you're already familiar with those you won't need to learn a new set. Also, VDO loads and executes without the time-wasting introductory screens WordStar uses for advertising and copyright information. You can execute VDO, load a file, make a quick correction, and store the corrected file in less time than it would take WordStar just to tell you about its licensing agreement.

VDO's only major drawback is that it is strictly a memory-based editor. That is, both the program itself and the entire file being edited must reside in memory at the same time. On a 64-kilobyte CP/M system, this would leave about 52K of memory for your working file. Unless you're working on the Great American Novel, though, this should be plenty of space for most of your editing needs.

For day-to-day editing that's both quick and easy, I recommend VDO. And best of all is the price: other than downloading time, it's free.

Modem programs

One of the things I've noticed from some of the letters I've been receiving is that there seems to be a lot of confusion about the various telecommunications programs available for the Heath/Zenith computers. Therefore, in each of the next several columns, I hope to discuss one of the many public domain communications programs.

Far and away the most popular and most common of the telecommunications programs is MODEM. MODEM was first written several years ago by Ward Christensen, and was one of the very first programs of its type. Before long, it was adapted for most types of computers.

One of the keys to its popularity was the standardization of the program and the development of "overlays" which could be used to configure the program to a particular computer. All you needed was any version of MODEM and the overlay written for your computer. Using CP/M's DDT utility, you could patch the overlay into MODEM; then you could have it running on your system. More recently, programs such as MLOAD have been written which will automatically install the overlay, requiring no knowledge of DDT.

MODEM has gone through many revisions and changes over the years. I happen to be using version 7.30, although there have been more current revisions which I have not yet obtained.

The MODEM program is often found under the title MDMxxx.COM, where xxx is the revision number. (For instance, my MODEM 7.30 is found as MDM730.COM). Overlays are written in assembly language, and their titles reflect the MODEM version to be used, the computer for which the overlay is written, and the revision of the overlay itself. For example, an overlay for any of the MDM7xx

programs to be used with the H8 and H89 might be titled M7H8-1.ASM.

The more subtle functions of the MODEM programs are too numerous to cover in great detail here. I will, though, mention the terminal mode and the XMODEM transfer function.

Selecting the terminal mode of the program simply turns your computer into a dumb terminal. In this mode, what you type on your keyboard is transmitted to the remote system, and what the remote system transmits is displayed on your screen. Additional features allow you to save incoming text into a disk file, copy screen information onto a printer, or transmit an existing text file from a disk.

The send and receive functions will allow you to exchange files with a remote system using the XMODEM transfer protocol. The nuts and bolts of XMODEM transfers are not important to know for operation; suffice it to say that XMODEM provides an error-checking system to ensure that the information transmitted has arrived intact and correct. XMODEM is used with most bulletin board systems for file-transfer functions.

For reliable no-frills daily use, MODEM is an excellent choice for a telecommunications program. However, there are always users who need the extra "bells and whistles" on their program. Next time, I'll discuss MEX, a second-generation modem program which grew from the original MODEM series.

Write-Hand Man—update

Last time, I discussed the desktop utility program for CP/M, Write-Hand Man. I mentioned that I was having problems with dropping characters while using WHM with any telecommunications program and a modem. I found the solution to that problem in a rather roundabout way.

My trusty old H89 until recently has been chugging along unmodified, running at a 2-megahertz clock speed.

Anyone who says eight-bit systems are dead should take a look at my mailbox.

By way of review, the H89 was manufactured with a standard Z80 central processing unit (CPU) which operated at a clock frequency of 2 MHz. After Zilog introduced the 4-MHz Z80-A, several hackers and manufacturers developed modifications to the H89 to install a Z80-A microprocessor chip running at 4 MHz. I never got around to modifying mine, so when I got an offer from Micronics Technology of Niceville, Florida, to test their new 4-MHz mod, I jumped at the chance. (I'll be discussing this product in detail in a future column.)

After installing the mod, I ran it through tests with a variety of programs that I had on hand. Just for the heck of it, I decided to try it with Write-Hand Man and a modem. Lo and behold, the problem of losing characters disappeared. A quick call to Technical Micro Systems, Inc. (which distributes WHM) confirmed that all their developmental work was done on a 4-MHz H89, and they had never run into my problem. If you want to use both Write-Hand Man and a modem, then, you'd better have a 4-MHz Z80-A installed.

Anyway, with that problem cleared up and TMSI's graphics adaptations to WHM, I have to revise my opinion to a hearty recommendation. While WHM is very disk oriented, the handy features it adds to a system more than offset its slight sluggishness. And as I mentioned last time, it should really shine on a system with a RAM disk.

While I was talking with TMSI, by the way, they mentioned that several new improvements have been added to the current release of WHM. I hope to be receiving a new copy soon, and I'll report on its performance in the near future.

GEnie system—update

Last time, I discussed a new telecommunications service from General Electric Information Systems called GEnie. Since then, GEnie has been growing by leaps and bounds and is looking better

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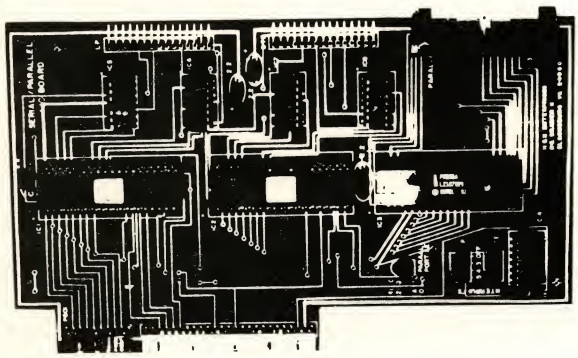

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Replace the H88-3 to upgrade your system or use the KC 1222 in place of it! Providing the two standard serial ports PLUS three parallel ports on one card, you have the best of both worlds! Use the parallel ports for printers, joystick, intrumentation/controll...KC 1222 has components including cables and hardware. KP 1222 has the same items less the serial chips and serial cables.

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every day.

As I stated previously, GEnie is still nowhere near as extensive a system as CompuServe. However, we eight-bit diehards may have just found ourselves a new home. The CP/M RoundTable (like a Special Interest Group on CompuServe) is turning into one of the most exciting and useful bargains around. Credit goes to system operator Keith Petersen and company.

The most exciting feature of the CP/M R/T is its public domain software library. As of this writing, there are well over one thousand files available on-line, with more being added every day.

Note that I said files, not programs. Groups of related programs are combined into "libraries" for convenience in downloading and for conservation of disk space. (Maybe a discussion of the public domain library utility program LU.COM would be in order in the near future.) In actuality, several thousand individual programs are available on-line.

Keith is also undertaking an ambitious and useful project. He is in the process of placing the entire SIG/M public domain software library into the system. SIG/M is the brainchild of the Amateur Computer Group of New Jersey, which serves as a clearinghouse and distribution point for organizing public domain software. Their library includes over 200 disks full of programs, utilities, languages, games, etc.; they are all in the public domain and yours for the asking. Now if you subscribe to GEnie, you can obtain these collections without even leaving home.

And GEnie is offering an added bonus to subscribers: free connect time while uploading programs. If you have a favorite public domain gem that you'd like to share with others, now you can upload it to the system at no charge. And the SYSOP tells me that GEnie has promised virtually unlimited disk space available for storage.

Public domain software is a useful and important asset to the microcomputer community. It's nice to see a system orienting itself towards gathering and distributing this software. Inside word is that GEnie will also be introducing some mind-blowing new features in the near future, including world-wide communications capability.

At $18 for membership and $5 per hour even at 1200 baud, GEnie is shaping up to be one of the best bargains around. I highly recommend it.

(For more information, you can call GE at 800/638-9636, extension 21. Also, you can get a free demo and sign up on-line with your MasterCard or Visa number. Set your modem for half duplex, 300 or 1200 baud, and dial 1-800/638-8369. After connection, enter HHH<RETURN>. At the U#= prompt, enter 5JM11999,GENIE<RETURN>.)

From the mailbag

Anyone who says eight-bit systems are dead should take a look at my mailbox. In less than a week since my first column was released in print, I received over thirty replies from readers, with more coming in every day. That's great! As a writer, I can't tell if I'm properly addressing your needs unless I hear from you, and a little positive support is always encouraging. (A quick note to the folks at *Sextant* to let them know you enjoy the column doesn't hurt, either.)

I have received quite a bit of information from vendors, and I will be sorting through and covering it in the future. I expect to be sorting vendor information into three categories.

First: products and software submitted for review. These will, to the best of my ability, be tested and evaluated fairly and completely, with the results covered in upcoming columns.

Second: informational product literature. All information received will be inspected and, if applicable, mentioned in future columns. Understandably, coverage cannot be thorough without a hands-on inspection.

Third: anybody out there? Vendors, even if you haven't done anything new for eight-bit computers in years, if you still support these products, drop me a note. I am hoping to compile a list of vendors that still provide products and support for eight-bit systems.

Gripes

It's good to hear your complaints as well as your positive comments, but there

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Circle #229 on Reader Service Card

are two gripes in particular I'd like to touch on here.

By far the most common complaint I've received in the mail has been from those who are furious because their H8/H89s have been "abandoned" by Heath/Zenith.

While support for eight-bit machines has been on the decline, I don't feel all the blame should fall on the manufacturer. There are lots of folks still getting plenty of mileage out of their Volkswagen Beetles, even though Volkswagen hasn't manufactured them for years. You should look on your computers in the same way. Manufacturers' actions are understandably directed more toward creating new sales than babysitting old ones. As I've said before, if your computer still does what you bought it for, it can't be obsolete.

Second most common are those who are fed up with *Sextant*, *Buss*, *REMark*, *H-Scoop*, etc., because they rarely publish articles about eight-bit machines.

Part of the problem is inevitable. We'd really like to see every issue devoted entirely to *our* machine. Everybody thinks that way sometime. However, if only a half or a third of a magazine's readers have a given machine, we can't expect to see the whole issue devoted to it.

There are, though, ways we can remind folks of our presence. Letters to the editor and sending in reader-service cards are probably the two most important. Make sure they know how many of you have H8s or H89s.

Yes, sometimes magazines may snub a machine because it's "not new enough." But the real danger is that users will stop writing and stop reading. We stop thinking about how we can put the machine to good use, then we dump the machine because "nobody" cares about it. It's the old idea of a self-fulfilling prophecy.

Just as importantly, publishers can't print articles unless someone writes them. One reason there are fewer 8-bit articles published is that fewer articles about 8-bit machines are being written. I wanted to see a *Sextant* column devoted to 8-bit machines. The best way to get one was to write it myself, so I did.

Next time, before you gripe, why not sit down and put something on paper?

The easiest way is just to drop a note: ask the magazine if they want an article on such and such. If you've done something interesting, let them know! (With *Sextant*, anyway, it's probably easier for a writer to ask first to see if they're interested. But they'll look at an article at any stage in development.) And even if you're not a computer hot shot, you may know some people who are. Encourage them to write.

Each magazine can print only a small handful of articles each month. There are thousands of H8 and H89 owners out there. Imagine what would happen if just a dozen sat down to write.

So get off your duffs!

Winding down

Send me your questions, comments, and gripes. If you need a personal reply, please include a self-addressed stamped envelope. As always, electronic mail gets answered first (GEnie preferred).

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Circle #134 on Reader Service Card

BASIC Fractals

Here's some BASIC software for the '100 and '150 that allows you to transcend the typical simplicity of computer graphics and explore a complex frontier. Warning: The colorful designs take more time to draw than circles and squares.

Edward A. Byrnes

"Fractals" are on the cutting edge of computer-generated graphics. Realistic landscapes, mountains, valleys, and lakes have been produced using fractals for some recent motion pictures, most notably in *The Last Starfighter* and in some of the *Star Wars* film series.

Equally interesting are the strange "abstract" pictures that have been created using fractals. Somehow not "realistic," somehow not really "abstract," they hover in the middle somewhere. They seem to be something, but we're not sure what.

Because these graphic displays can be so spectacular, many people may think that they can't be handled by the ordinary computer hobbyist. That's not true, though. The basic mathematics of at least the "abstract" fractals are more than simple enough to be handled by BASIC on a Z100 or Z150.

(The big cost is *time*: a fractal program takes *lots* of it. But even that can be made less inconvenient.)

In the August 1985 issue of *Scientific American*, A. K. Dewdney's "Computer Recreations" column featured some beautifully abstract graphic displays. The text of the column described the structure of a program that would produce "parameter-space" fractals on a personal computer. These parameter-space images reproduce the "Mandelbrot Set" and a colorful border surrounding the set. This article will discuss "parameter-space" images and another interesting type called "dynamical-plane" images. These two types of images and the Mandelbrot Set are discussed below.

Listed here are programs for Z-BASIC on the Z100 (Listing 1) and GW-BASIC on the Z150 (Listing 2). (The two programs are basically the same, and the line references below will apply to both unless otherwise noted.) The programs will produce dynamical-plane images and, with the modification of one or two lines, parameter-space images. The programs were based on the description in *Scientific American*; they will enable you to create colorful fractal images and to explore the mathematics of fractals.

I will also present some modifications to the basic fractal programs and give some other programs to allow you to load the images created, view them, and make color changes to them.

Edward A. Byrnes is a former Marine and philosophy student. He owns a software company, Intuitive Logic, in Rochester, Michigan.

Fractional dimensions

Benoit B. Mandelbrot developed the idea of fractal geometry in the 1970s while working at IBM's Thomas J. Watson Research Center. Mandelbrot holds to ideas that go against the strict classical Euclidian geometry of one, two, or three dimensions. He holds to the view that dimensionality is not restricted to three distinct dimensions. Rather, he says, dimensionality is a continuum, and there are an infinite number of fractional dimensions. For example, a line drawn in a rather complex pattern might have a dimensionality of 1.8, 1.132, or 1.696.

As a brand new field, fractal geometry is still in the "observation" stage.

I won't be going into the ideas behind fractional dimensions here. Those of you who are interested might want to look at some other articles on the subject. Two of interest are Peter R. Sorensen's article, "Fractals," in *Byte* magazine, September 1984, and Kathleen Stein's "The Fractal Cosmos," in *Omni*, February 1983.

As a brand new field, fractal geometry is still in the "observation" stage. For now, the practical thrust seems to lean toward new and more precise mathematical models (and computer simulations) for physics and biology.

Fractal geometry is being applied to the fields of physics, biology, economics, sociology, astronomy, and geology—to name just a few. Fractals let mathematicians and scientists describe complex forms and seemingly chaotic patterns.

Some of Mandelbrot's most important works highlight the inability of Euclidian geometry to describe natural forms. He points out that mountains are not really cones, clouds are not spheres, and shorelines are not parts of circles.

Imagine trying to use conventional mathematics to calculate the volume or shape of a cloud, mountain range, or tree. The math would be infinitely complex. Relatively simple equations of fractal geometry, however, will produce results that closely model such diverse ideas as the fluctuation of stock-market activity, molecular motion, the growth of plants, the distribution of minerals, memory activity, vegetation patterns, and the clustering of galaxies.

The computer, then, can imitate nature with programs that use fractal equations. Also, we can explore regions of abstract math, using our computer as a window to see things that would normally defy our imagination or descriptive ability.

The actual mechanics of producing fractals don't require worrying about puzzles of dimensionality or high-level math. Instead, they are based on an old (and also somewhat puzzling) friend from high-school mathematics: complex numbers.

The complex plane

Remember from high-school or college math class that the small letter "i" is the symbol used to represent the "imaginary" number equal to the square root of -1. And if you don't have to refresh yourself on the subject (as I had to), you will know that a complex number is a real number plus an imaginary number in the form 1 + i, 27 - 35i, -34 + 456i, etc.

All complex numbers can be represented as points in "the complex plane."

The complex plane can be visualized as all the points on an x-y graph where the x-axis represents real numbers and the y-axis represents imaginary numbers. (See Figure 1.)

In FRACTAL.BAS, we will display an area in the complex plane by repeatedly recycling the values in one equation:

$Z = Z^2 + C$

This is the fractal equation used in the programs presented here. It is only one of many that could be used.

(No, this won't give us mountains and landscapes. Using a formula such as this produces a *non-random* fractal. *Random* fractals are used to produce the spectacular scenery that intrigues filmmakers and others.)

```
10 CLS:PRINT "Ed Byrnes's Fractal Image Generator":PRINT:REM Z-100 VERSION
20 ON ERROR GOTO 370:FILES"????????.RED":FILES"????????.GRN":FILES"????????.BLU"
30 PRINT "The picture files above are presently on this drive."
40 INPUT"NAME OF THIS FRACTAL (do not use . or extension)";A$
50 INPUT "LAMBDA AND SIDE";ACORNER,BCORNER,SIDE:GAPX=SIDE/640:GAPY=SIDE/225
60 INPUT"START AT ROW: (Row 1 if new image) ";M1
70 PRINT "Bload partial fractal image? (Y/N)":ZZ$=INPUT$(1)
80 IF ZZ$="Y" OR ZZ$="y" THEN CLS:GOSUB 330 ELSE CLS:GOTO 90
90 FOR M=M1 TO 224:FOR N=1 TO 639
100 AC=(N*GAPX)+ACORNER:BC=(M*GAPY)+BCORNER:GOSUB 160
110 AZ=0:BZ=0
120 ZZ$=INKEY$:IF ZZ$="Z" THEN GOSUB 270:END
130 IF SIZESQ=>4 THEN PSET(N,M),V
140 COUNT=0:SIZESQ=0
150 NEXT:NEXT:LOCATE 1,1,1:GOSUB 270:END
160 AX=AZ^2-BZ^2+AC:BX=2*AZ*BZ+BC:AZ=AX:BZ=BX:SIZESQ=AX^2+BX^2
170 IF SIZESQ=>4 THEN GOSUB 190:RETURN
180 COUNT=COUNT+1:IF COUNT<100 THEN 160 ELSE RETURN
190 IF COUNT>50 THEN V=5
200 IF COUNT>25 AND COUNT<=50 THEN V=7
210 IF COUNT>15 AND COUNT<=25 THEN V=4
212 IF COUNT>8 AND COUNT<=15 THEN V=6
214 IF COUNT>7 AND COUNT<=8 THEN V=2
216 IF COUNT>5 AND COUNT<=7 THEN V=1
220 IF COUNT>3 AND COUNT<=5 THEN V=3
230 IF COUNT>2 AND COUNT<=3 THEN V=1
240 IF COUNT>1 AND COUNT<=2 THEN V=3
250 IF COUNT=>0 AND COUNT<=1 THEN V=1
260 RETURN
270 DEF SEG=&HE000:BSAVE A$+".GRN",0,64000!
280 DEF SEG=&HD000:BSAVE A$+".RED",0,64000!
290 DEF SEG=&HC000:BSAVE A$+".BLU",0,64000!
300 PRINT "NAME: '";A$;"'":PRINT"LAMBDA:";ACORNER;",";BCORNER
310 PRINT "SIDE:";SIDE:PRINT"ROW:";M:PRINT "(Write":PRINT"this":PRINT"down!)"
320 RETURN
330 DEF SEG=&HE000:BLOAD A$+".GRN",0
340 DEF SEG=&HD000:BLOAD A$+".RED",0
350 DEF SEG=&HC000:BLOAD A$+".BLU",0
360 RETURN
370 IF ERR=53 THEN PRINT "No picture files found!":RESUME 30
```

Listing 1. A Z-BASIC program which will generate fractals on your Z100.

```
10 CLS:PRINT "Ed Byrnes's Fractal Image Generator":PRINT:REM Z-150 SERIES
20 ON ERROR GOTO 370:FILES"????????.PIC"
30 PRINT "The picture files above are presently on this drive."
40 INPUT"NAME OF THIS FRACTAL (do not use . or extension)";A$
50 INPUT "LAMBDA AND SIDE";ACORNER,BCORNER,SIDE:GAPY=SIDE/200:GAPX=SIDE/320
60 INPUT"START AT ROW: (Row 1 if new image) ";M1
70 PRINT "Bload partial fractal image? (Y/N)":ZZ$=INPUT$(1):SCREEN 1:COLOR 0,2
80 IF ZZ$="Y" OR ZZ$="y" THEN CLS:GOSUB 330 ELSE CLS:GOTO 90
90 FOR M=M1 TO 200:FOR N=1 TO 319
100 AC=(N*GAPX)+ACORNER:BC=(M*GAPY)+BCORNER:GOSUB 160
110 AZ=0:BZ=0
120 ZZ$=INKEY$:IF ZZ$="Z" THEN GOSUB 270:END
130 IF SIZESQ=>4 THEN PSET(N,M),V
140 COUNT=0:SIZESQ=0
150 NEXT:NEXT:LOCATE 1,1,1:GOSUB 270:END
160 AX=AZ^2-BZ^2+AC:BX=2*AZ*BZ+BC:AZ=AX:BZ=BX:SIZESQ=AX^2+BX^2
170 IF SIZESQ=>4 THEN GOSUB 190:RETURN
180 COUNT=COUNT+1:IF COUNT<100 THEN 160 ELSE RETURN
190 IF COUNT>50 THEN V=1
200 IF COUNT>25 AND COUNT<=50 THEN V=2
210 IF COUNT>15 AND COUNT<=25 THEN V=3
220 IF COUNT>8 AND COUNT<=15 THEN V=1
230 IF COUNT>5 AND COUNT<=8 THEN V=2
240 IF COUNT>2 AND COUNT<=5 THEN V=3
250 IF COUNT=>0 AND COUNT<=2 THEN V=1
260 RETURN
270 DEF SEG=&HB800:BSAVE A$+".PIC",0,64000!
300 PRINT "NAME: '";A$;"'":PRINT"LAMBDA:";ACORNER;",";BCORNER
310 PRINT "SIDE:";SIDE:PRINT"ROW:";M:PRINT "(Write":PRINT"this":PRINT"down!)"
320 RETURN
330 DEF SEG=&HB800:BLOAD A$+".PIC",0
360 RETURN
370 IF ERR=53 THEN PRINT "No picture files found!":RESUME 30
```

Listing 2. A GW-BASIC program which will generate fractals on your Z150.

$Z = Z^2 + C$

In the formula used here, both Z and C are complex numbers. We will start out by setting Z equal to C, then perform the calculation again and again; each successive value of Z will be the result of the previous iteration.

Since Z is a complex number (X + Yi), the mathematics of multiplying with it—as in Z x Z—is just like that of multiplying ordinary binomials:

$(X+Yi) \times (X+Yi) = X^2 + 2XYi + (Yi)^2$.

Here, X is the real component and Y is the imaginary component. We just have to remember that i x i gives -1; so, Yi x Yi gives us $-Y^2$.

Let's say that we set C equal to 1 + 1i. The initial value of Z is the same. The result of the first iteration, then, will be

$Z = (1^2 + 2[1i] + [1i]^2) + (1 + 1i)$
$= (1 + 2i - 1) + (1 + 1i)$
$= 1 + 3i$

That gives the value of Z for the next iteration. The second iteration will produce

$Z = (1^2 + 2[3i] + [3i]^2) + (1 + 1i)$
$= (1 + 6i - 9) + (1 + 1i)$
$= -7 + 7i$

The third will give us

$Z = ([-7]^2 + 2[-49i] + [7i]^2) + (1 + 1i)$
$= (49 - 98i - 49) + (1 + 1i)$
$= 1 - 97i$

And we can go on and on.

Continuing this iteration, you'll see the size of the complex number Z getting larger. Here, "size" does not mean just a large value of the real or imaginary parts. The size of a complex number is its distance away from the 0 + 0i point on the complex plane. That distance is given by the hypotenuse of a right triangle, where the real value is the base and the imaginary value is the height. (The complex number 3 + 4i, then, has a size of 5.)

In his article, Dewdney pointed out the critical element here: the math is such that if Z reaches a size of 2 at any particular point in the iterations of the formula, then succeeding iterations will drive it to

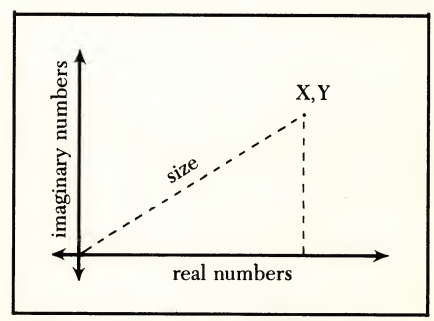

Figure 1. The complex number plane. X + Yi is represented by the point at the coordinates X,Y. The "size" of X + Yi is the hypotenuse of the right triangle formed using X as its base, and Y as its height.

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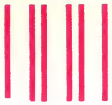

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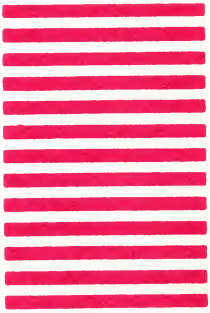

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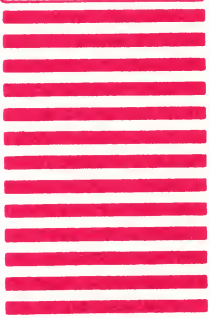

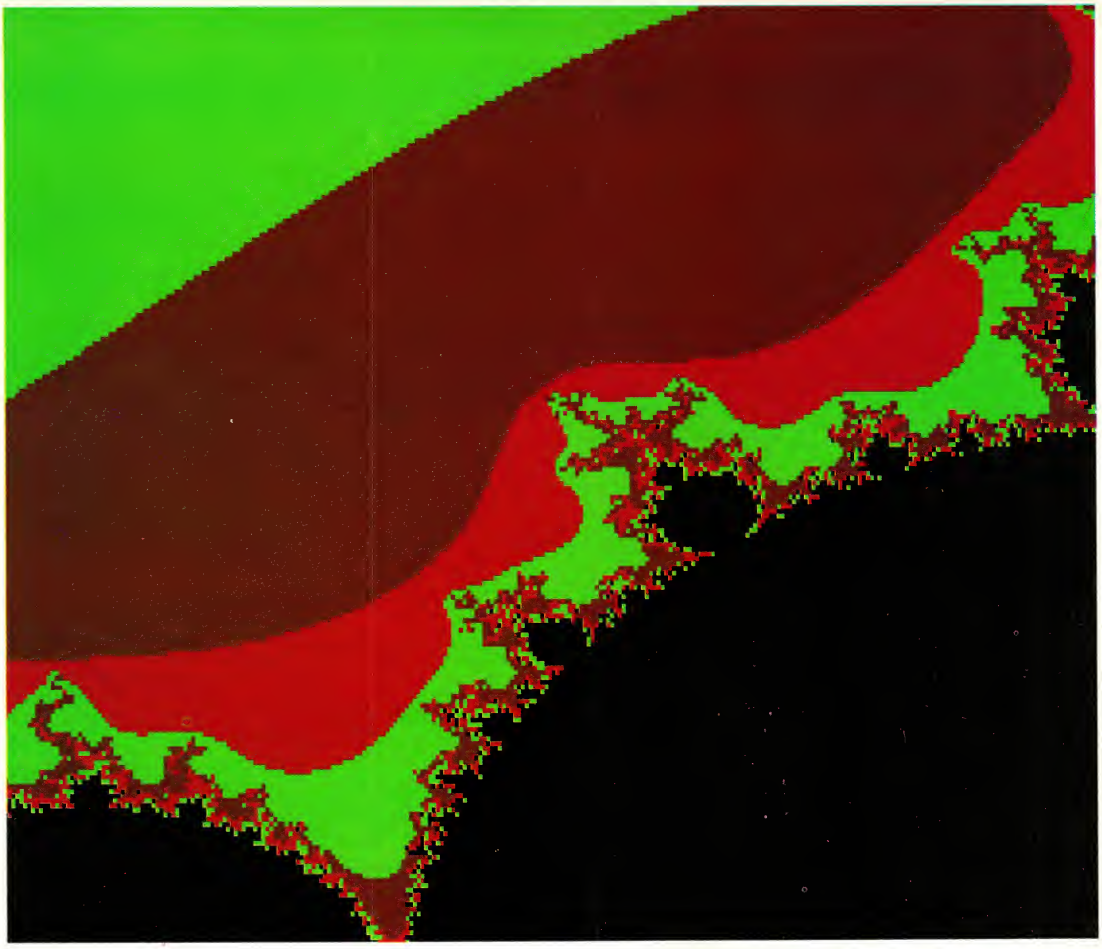

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infinity. The Mandelbrot Set is the set of complex numbers in which the size (the hypotenuse) never reaches 2, even after the result of the equation above has been plugged back into itself an indefinite number of times. (In *Scientific American*, Dewdney used 1,000 times as a working value; I used 100.) The Mandelbrot Set is a mathematical focus of fractal geometry, just as cones, cubes, and spheres each form a focus of Euclidian geometry.

Producing the image

But by now you are probably wondering what this really has to do with fractal *images*.

In effect, each pixel of our image is going to represent a number in the complex plane. For a given pixel, the value of C represents a point on the complex plane mapped to pixel coordinates on the screen of the Z100 or Z150. We will plug that number (or pixel value) into $Z = Z^2 + C$ and evaluate the formula for that pixel. Then we will do the same for the pixel's nearest neighbor, and so on; we will calculate $Z^2 + C$ for all the other pixels in the whole area of the complex plane represented by the screen.

This gives us two levels of iteration, one nested inside the other. In the inner level, the program will calculate the formula $Z = Z^2 + C$ for a given pixel—performing as many as 100 iterations on each pixel. In the outer level, the program will calculate a starting value for each succeeding pixel.

As you can see, C will change slightly for each new pixel: a small fraction will be added to C at the beginning depending on the pixel's row and column position. For a given pixel, the program will calculate $Z^2 + C$ for 100 iterations or until the square of the size of Z exceeds 4. (This is the same as solving for the size of Z exceeding 2; by using the square, we save the computer one square root step per iteration.)

After the calculations for one pixel are complete, the program adds the small fraction to C depending on the next pixel's row and column position; then it starts all over again.

A color will be assigned to the pixel depending on how fast the square of the size reaches 4. Those inside the Mandelbrot set will be colored black. At the other extreme, pixels whose size squared reaches 4 with one iteration will be colored blue. Dewdney assigns colors based on their value in spectrum order, i.e., from red to blue. I've used a high-contrast color scheme; yellow shows up much better next to red or blue than next to green or white. Color assignment is up to the programmer; you can customize it to taste. (A simple modification, noted below, will change the program for a monochrome display.)

In effect, then, the idea of a fractal is strangely simple: for a given formula, it is *the color representation of a mathematical property* (how fast it approaches infinity based on particular starting values).

(But you can see that it will take a *lot* of time to produce a screen. The program for the Z100 calculates starting values for 144,000 pixels, then iterates the formula as many as 100 times for each pixel. That could be 14,400,000 calculations!)

Before going further, definitions of the program variables may be useful for clarification.

The main variables

LAMBDA (in line 50) is just the name for the initial two-variable complex number establishing the lower-left corner of the area of the complex plane to be displayed. The complex number is composed of ACORNER and BCORNER, where ACORNER is the real component and BCORNER the imaginary. These values are input by the user to establish the initial values for Z and C in $Z^2 + C$.

(Normally, our complex number would be written in the form ACORNER + BCORNERi. As long as we treat BCORNER as an imaginary number within the program, however, the use of the symbol "i" is not necessary.)

SIDE is the variable that determines the size of the complex plane area to be examined. Because of this, it is the variable that determines the "magnification power" of subsequent generations of fractal displays. Say we ran the program with a SIDE of 1; then, using the same LAMBDA value, we could run the program again with a SIDE of .5. If so, we would "magnify" a quarter of the first display.

The program creates a fractal display on the Z100 that is 639 pixels across and 224 pixels down (for any value of SIDE). (This is 319 by 200 on the Z150.) Running it with a SIDE of 1 and subsequently using a SIDE of .5 would magnify what had been shown in a 320 x 112 pixel area of the first 639 x 224 pixel grid. A SIDE of .1 would magnify a 64 x 22 pixel area of the first fractal display.

In line 100, AC and BC are assigned initial values. As the program moves to

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each succeeding pixel, it will calculate a different starting value of C: it will add together the values of N*GAPX and ACORNER to produce AC, and add together the values of M*GAPY and BCORNER to produce BC. (GAP will be discussed in just a second.) ACORNER and BCORNER, the components of the original complex number (LAMBDA), remain constant throughout the program.

M and N in line 90 hold the values for the current row and column of the pixel being evaluated. (The variable M1 keeps track of the row or "y" coordinate for any subsequent stopping and restarting of partially complete fractal images.)

GAPX (in line 50) is set equal to SIDE divided by the number of pixels along the display's x axis. GAPY is set equal to SIDE divided by the number of pixels along the display's y axis. In line 100, these constants are used to compute values of AC and BC for each succeeding pixel. The value of GAPX is multiplied by the column value N, and the product is added to the constant ACORNER to produce AC. Similarly, the value of GAPY is multiplied by the row value M, and the product is added to BCORNER to produce BC. AC and BC together constitute C, so we can calculate the equation $Z = Z^2 + C$ for each succeeding pixel.

(Dewdney calls for one variable GAP, but that is for a 400-pixel square grid. By using the two values, GAPX and GAPY, we can correct for the rectangular pixel grid of our display.)

In line 130, the variable V after the PSET command is the color variable. Its value is dependent upon how long it takes the variable SIZESQ to reach 4. (SIZESQ is calculated in line 160).

SIZESQ is the square of the hypotenuse formed by the real and imaginary components of Z. So, SIZESQ is the sum of the squares of AC and BC.

In line 180, the variable COUNT is incremented by 1 each time the result of the equation used does not reach a SIZESQ of 4 or more. If SIZESQ reaches 4, then the PSET in line 130 turns on a pixel; also, COUNT is reset to 0 in line 140—along with SIZESQ. (In this particular program, COUNT is also reset to 0 when it reaches 100.)

Starting out

Now we can move to a line-by-line explanation of the Z-BASIC version of the FRACTAL program. The GW-BASIC version is the same except for the SCREEN, COLOR, BSAVE, and BLOAD commands.

Line 40 asks the user to name the fractal disk file to be produced by the program; it also checks whether there are image files stored on the current drive; if so, they are listed. A name can be chosen from this list or a new name assigned. If you are using a hard drive to store the images, and you are about to create a new image, be sure to use a new name; otherwise the first image will be "written over."

Line 50 asks the user to enter values for the complex number LAMBDA (to be used for the calculations) and to enter a value for SIDE. The numbers are entered as three real numbers separated by commas. The second of the three numbers is treated as an imaginary number, even though you do not use the symbol "i".

For example, if your complex number (LAMBDA) were -.678 + .04i and the SIDE were 1, you would enter -.678,.04,1.

The variable SIDE enables you to "zoom" in or "zoom" out on the graphic picture. If at a later session you entered a value of 2 for SIDE, the effect would be like reducing the magnification on a microscope; entering a value smaller than 1 would increase the magnification.

My suggested ranges of values for LAMBDA are 0 to -2 for the real part, and 0 to -1.25 for the imaginary part. However, this program is intended for experimentation; by entering values other than those suggested, the biggest risk you run is that you might end up with a screen of all one color, or with everything in the Mandelbrot Set—leaving you with a blank screen. A method of avoiding this is detailed below.

Give the program time to run; you may not see anything on the screen even after an hour of run time, even with good LAMBDA and SIDE values. (Also see "Testing new values," below.)

Taking your time

Line 60 asks the user to enter the row value (M1). To start a new fractal picture, a "1" should be entered, since we will want the display to begin at the first row of pixels, then work down.

As noted above, the process is slow; I suggest you plan on all-day or overnight runs of the program. If your machine has an external monitor, it can be turned off for the overnight processing. Most other peripherals can be turned off—except, of course, the computer and the device to which the image will be written when it is complete. If you can't turn off the monitor, turn the brightness down.

However, you may not like the idea of letting your computer run unattended for long periods of time. For this reason, the program is written so that you can stop the creation of the picture and start it again where it left off. To do this, you must keep track of the fractal name, the values of LAMBDA and SIDE, and the row value (M1) where the picture was stopped.

Whenever you type a capital "Z", the picture is saved, and the values needed to restart the picture are printed to the screen. The partial display will have been saved to disk. Then line 300 will give you two of the constants you started the fractal with: the fractal name and the values for LAMBDA (ACORNER and BCORNER). Line 310 will give you your SIDE value and current ROW value (M1). It is a good idea to write them all down at this point.

When you restart the program, enter the name of the fractal, then your initial LAMBDA and SIDE values. When asked for the row coordinate, enter the M1 value that was printed.

Line 70 asks the user if a previous picture should be loaded. If you are completing a picture, then the answer is "Y". If it is a fresh start on a new picture, then the answer is "N". If the answer is "Y", the program GOSUBs to the BLOAD routine in lines 330-360, and returns to line 90.

The math

Line 50 calculates the values for GAPX and GAPY, which are the SIDE divided, respectively, by the number of horizontal and vertical pixels.

In line 100, we create AC and BC by adding the small fractions (N*GAPX and M*GAPY) to the constants (ACORNER and BCORNER). This gives us the "corner" value for each succeeding pixel. Then, for each iteration of the formula on this pixel, we can calculate the square of the hypotenuse, which will give us the SIZESQ of Z.

Line 100 also has a GOSUB that directs execution to line 160, where the main calculations for the $Z^2 + C$ equation take place. The variables in line 160 require more explanation of the equation $Z = Z^2 + C$.

AZ and BZ (and AX and BX) are variables that represent the real and imaginary parts of our complex numbers. They are used to keep track of the numerous substitutions used in the program. In Z-BASIC or GW-BASIC, we can treat BZ and BX as imaginary numbers and drop the "i".

With Z equal to AZ + BZ, and C equal to AC + BC, $Z = Z^2 + C$ would ordinarily be:

```
Z = (AZ+BZ)^2 + (AC+BC)
```

In long form, this would be:

```
Z = AZ^2 + 2*AZ*BZ + BZ^2 + (AC+BC)
```

However, squaring the square root of a negative number (BZ) produces a negative number. So, we must change the sign of BZ^2 to negative. This is in keeping with treating BZ as an imaginary number. So the equation is changed from:

```
Z = AZ^2 + 2*AZ*BZ + BZ^2 + (AC+BC)
```

to:

```
Z = AZ^2 + 2*AZ*BZ - BZ^2 + (AC+BC)
```

With some algebraic manipulation, the last equation can also be written as:

```
Z = (AZ^2 - BZ^2 + AC) +
    (AZ*BZ + AZ*BZ + BC)
```

In line 160, AX and BX are set equal to the two components of the equation:

```
AX = AZ^2 - BZ^2 + AC:
BX = BZ*AZ + BZ*AZ + BC
```

So now:

```
Z = AX + BX
```

Also in line 160, I change AX back to AZ and BX back to BZ.

I found this substitution to be necessary. Initially, I thought I could use the following form:

```
AZ = AZ^2 - BZ^2 + AC:
BZ = BZ*AZ + BZ*AZ + BC
SIZESQ = AZ^2 + BZ^2:
IF SIZESQ=>4 THEN GOSUB 190 : RETURN
```

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But this would change the value of AZ before I had calculated a new BZ, so a temporary substitution (AX and BX) is required.

Now we can get back to the original fractal equation, $Z = Z^2 + C$.

The initially entered complex-number coordinate will have 144,000 different values added to it (for a 640 x 225 pixel grid), and up to 100 substitution calculations are made for each pixel.

If the SIZESQ reaches 4 before 100 calculations take place, execution of the program goes to lines 190-260. Here, a color value V is acquired depending upon how many iterations of the equation had to take place before the SIZESQ did reach 4.

If the SIZESQ does not reach 4 even after 100 iterations, then line 130 does not PSET a pixel, leaving it black. The process then begins again on the next pixel in the grid.

For a monochrome display

FRACTAL.BAS can be easily modified for a monochrome display. Starting with line 190 and going down to line 250, make V = 0 on every other line; on the lines skipped, make V = 7. Your display will show the "layering" of the border that leads up to the Mandelbrot Set.

Array storage

I said that my programs were based on Dewdney's description in *Scientific American*; they differ in one respect: array storage.

The program description in *Scientific American* calls for entering all the SIZE values into an array and then assigning color. This method is restricted by the size of an array in Z-BASIC. Also, direct plotting enables the user to view partial displays and to decide if changes should be made in the LAMBDA values, color assignment, and grid size.

Some possible changes

There are a number of areas where you may want to experiment. Many program parameters can be changed for different effects.

Using the values of -2 and -1.25i for LAMBDA and 2.5 for SIDE, FRACTAL.BAS will produce an image very similar to the Mandelbrot Set image found in Dewdney's *Scientific American* article. Through testing, I found that 100 iterations would produce a fairly dazzling display.

Examining lines 216 to 250 of the Z100 version, you will see that every other color value is blue and cyan. This causes a layering effect in the border leading from the edges of the display to the Mandelbrot set itself. Lines 216 to 250 could be deleted and line 250 replaced with:

```
IF COUNT=>0 AND COUNT<=7 THEN V=1
```

The effect of this change would be an unvaried blue leading to the other colors that are closer to the Mandelbrot Set. For

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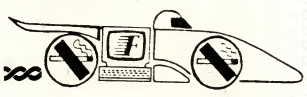

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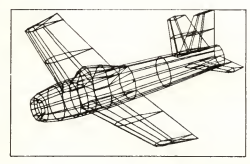

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magnification, using the same LAMBDA value and a smaller SIDE, you may find that there are only a few colors displayed. (This would occur because SIZESQ is reaching 4 only after at least 50 iterations.) In this case, you may want to increase the COUNT to 200 and divide up the color values in the range of 50 to 200 counts.

At the other extreme, you may find that the SIZESQ for some complex numbers reaches 4 within 1 to 50 iterations. (Pixels will be PSET quickly to the screen, and all the pixels will be one color.) In this case, you may want to reduce the COUNT to 50 instead of 100, and again divide the colors within this range.

If SIZESQ reaches 4 within 50 iterations, then change the COUNT (color) ranges in lines 190 to 240 to something similar to the following (and omit line 250):

```
IF COUNT>45 THEN V=2
IF COUNT>25 AND COUNT<=45 THEN V=7
IF COUNT>15 AND COUNT<=25 THEN V=3
IF COUNT>10 AND COUNT<=15 THEN V=5
IF COUNT>5 AND COUNT<=10 THEN V=6
IF COUNT>0 AND COUNT<=5 THEN V=4
```

Color order and range are open to experimentation and user customization.

If you would like your Z100 to be able to display three fractal images side by side, each one showing a magnified area of the image to its left, you can make the following changes.

To set the grid size to 200 x 200, change line 50 from:

```
GAPX=SIDE/640:GAPY=SIDE/225
```

to:

```
GAP=SIDE/200
```

To correspond with the changes to line 50, change line 100 from:

```
AC=(N*GAPX)+ACORNER:
BC=(M*GAPY)+BCORNER:
GOSUB 160
```

to:

```
AC=(N*GAP)+ACORNER:
BC=(M*GAP)+BCORNER:
GOSUB 160
```

Then run the program to get the first image.

Since the grid size is now 200 pixels across by 200 pixels down, three different fractal displays can be placed side by side on the screen. If you have completed one display and wish to place another next to it (with a little space between them), add

Looking at Other People's Work

Alan Norton, another mathematician at IBM, has produced a number of three-dimensional fractals. Mr. Norton works with a pixel area that is 1,200 pixels wide, 1,200 pixels long and 1,200 pixels deep. He can control the viewer angle as well as the angle of simulated light that strikes these three-dimensional fractal objects. Photographs of his creations can be found in back issues of *Siggraph* magazine; seeing them would be well worth a trip to a library that retains these back issues.

At Cornell, Dr. Hubbard has produced beautiful color photographs of 19 different fractal images. These are available from Artmatrix, P.O. Box 880, Ithaca, NY 14851. 11" x 14" color photographs are $15, and 16" x 20" color photographs are $25. Even if you do not buy a photo, it is worth sending $3 ($4 overseas) for the colorful brochure.

You can also purchase 36 different glossy-print fractal postcards and two FORTRAN programs for $9, which includes U.S. postage and handling. (Other products are also available. Send a self-addressed, stamped envelope to the above address for the price list.)

Unfortunately, the FORTRAN programs are not easily converted to the Microsoft FORTRAN Compiler for the Z100- or Z150-series computers. The programs from Artmatrix use a "complex integer" type which our MS-FORTRAN does not support.

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215 to the value of N in the PSET command in line 130:

```
IF SIZESQ=>4 THEN PSET(N+215,M),V
```

Also, be sure to answer the "BLOAD previous fractal?" question with "Y" so that when the second display is complete, the program saves both pictures.

To add a third fractal picture to the screen, add 430 to N instead of 215. (See Figure 2.)

When you reduce the SIDE called for in line 50, you are magnifying a smaller area of the first display. You will see that magnification not only makes the smaller area larger, it actually adds more detail.

If you wish to magnify an area other than the upper-left corner of any particular display, you must alter lines within the program. You must estimate the pixel coordinates of the upper-left corner of this chosen area. Since you know that the entire rectangle is 200 pixels across by 200 pixels down, you can make a rough guess at the coordinates of the upper-left corner of the section that interests you.

More exact coordinates can be found by using PSET or CIRCLE in the direct mode of Z-BASIC or GW-BASIC. With the display on the screen and the program ended, type CIRCLE(100,100),4,7, say, and see how close to the upper-left corner of the chosen area the circle is plotted. If it is to the right of the point you want, reduce the first coordinate; if it is too low, reduce the second coordinate; etc.

Once you are satisfied with the coordinates, line 90 and line 130 must be changed. Say the coordinates are 50,125. Line 90 would be changed to:

```
FOR M=M1+50 TO 200+50:
FOR N=125 TO 200+125
```

or to:

```
FOR M=M1+50 TO 250:
FOR N=N1+125 TO 325
```

And line 130 would be changed to:

```
IF SIZESQ=>4 THEN PSET(N+215-50,M-125)
```

The coordinates are added to the pixel values in line 90 and subtracted from the pixel values or coordinates in line 130. The "215" in line 130 centers the new magnified display.

The same method would be used when magnifying areas of a full-screen image. (You would not, however, add 215 and 430 to N, as you would if you were placing three images side by side.)

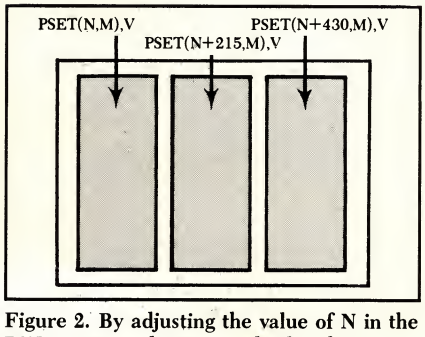

Figure 2. By adjusting the value of N in the PSET command, you can display three fractal images side-by-side on the screen.

Expansions of the program

The programs listed here are "bare bones," and code can be added to improve them. One improvement would be to add a data file to keep track of the LAMBDA, SIDE, and M values so that continued generation of a partial display is automatic.

Other lines could be added to automatically adjust the maximum COUNT and the color range.

A separate program can easily change the colors in a completed display. Still another program could be written as a "scanner." This program would automatically increment either value of LAMBDA and plot a few columns of the display; LAMBDA values that show multi-colored promise could be saved in a data file.

The VIEWER.BAS listings here for Z-BASIC (Listing 3) and GW-BASIC (Listing 4) are used either to load a completed image for viewing or to change colors on a completed image. After you have completed a graphic picture, you may wonder how the image would look with the red and blue colors switched, or the yellow and cyan, etc. VIEWER.BAS allows you to switch any two colors on any image. By running it again after the first change, any number of color switches can be made.

Testing new values of LAMBDA

Not all values used for LAMBDA will produce a satisfactory display. Combined with changes that may be made to SIDE, COUNT, and the color ranges, this means it would be convenient if we could quickly test new values. Here's a method I've used to track down some "jewels" of fractal images:

1. Set COUNT to 200 in line 180
2. Divide up the color range in lines 190-250 by multiples of 30 (or 200/7):

```
IF COUNT>170 THEN V=7
IF COUNT>140 AND COUNT<=170 THEN V=4
IF COUNT>110 AND COUNT<=140 THEN V=6
```

etc., through line 250

3. STEP the loops in line 90 by 10 and 20:

```
FOR M=M1 TO 224 STEP 10:
FOR N=1 TO 639 STEP 20
```

Now run the modified program with your new values of LAMBDA and the SIDE equal to 1. Say your lowest color value is 1 and you get a grid of all blue. From this you know that it only took up to 30 iterations for SIZESQ to reach 4. Reduce the

```
10 CLS:PRINT "Ed Byrnes's Fractal Image Viewer & Color Changer":PRINT:REM Z-100
20 ON ERROR GOTO 210:FILES"????????.RED":FILES"????????.GRN":FILES"????????.BLU"
30 PRINT "The picture files above are presently on this drive."
40 INPUT "Use which image (do not enter . or ext.)";A$
50 PRINT "Load to <V>iew or <C>hange colors?"
60 B$=INKEY$:IF B$="V" OR B$="v" THEN GOSUB 190:ZZ$=INPUT$(1):END
70 IF B$="C" OR B$="c" THEN GOSUB 190 ELSE 60
80 INPUT "EXCHANGE WHAT TWO COLORS e.g. (4,6)";A,B
90 PRINT "AFTER EXCHANGE IS COMPLETE PRESS 'S' TO BSAVE THE CHANGE"
100 PRINT "PRESS ANYTHING ELSE TO QUIT."
110 PRINT "PRESS ANY KEY NOW TO CONTINUE...":ZZ$=INPUT$(1):GOSUB 190
120 FOR X=1 TO 639:FOR Y=1 TO 224
130 PT=POINT(X,Y):IF PT=A THEN PSET(X,Y),B:GOTO 150
140 IF PT=B THEN PSET(X,Y),A
150 NEXT:NEXT:ZZ$=INPUT$(1):IF ZZ$="S" THEN GOSUB 160 ELSE END
160 DEF SEG=&HE000:BSAVE A$+".GRN",0,64000!
170 DEF SEG=&HD000:BSAVE A$+".RED",0,64000!
180 DEF SEG=&HC000:BSAVE A$+".BLU",0,64000!:RETURN
190 CLS:DEF SEG=&HE000:BLOAD A$+".GRN",0:DEF SEG=&HD000:BLOAD A$+".RED",
200 DEF SEG=&HC000:BLOAD A$+".BLU",0:RETURN
210 IF ERR=53 THEN PRINT "No picture files found!":RESUME 30
```

Listing 3. A Z-BASIC program which enables you to view fractals you've created on your Z100, and change their colors.

```
10 CLS:PRINT "Ed Byrnes's Fractal Loader and Color Changer":PRINT:REM Z-150 Ser.
20 ON ERROR GOTO 190:FILES"????????.PIC"
30 PRINT "The picture files above are presently on this drive."
40 INPUT"Fractal to use (do not use . or extension)";A$
50 PRINT"Load to <V>iew or <C>hange colors?"
60 B$=INKEY$:IF B$="V" OR B$="v" THEN T=1:GOTO 80
70 IF B$="C" OR B$="c" THEN T=2 ELSE 60
80 PRINT "WHICH COLOR PALETTE (1 OR 2)?"
90 C$=INKEY$:IF C$="1" THEN SCREEN 1:COLOR 0,1:GOTO 110
100 IF C$="2" THEN SCREEN 1:COLOR 0,2 ELSE GOTO 90
110 IF T=1 THEN 200
120 GOSUB 170:INPUT "SWITCH WHAT 2 COLORS (1,2) ETC.";A,B:GOSUB 170
130 FOR X=1 TO 320:FOR Y=1 TO 200:PT=POINT(X,Y)
140 IF PT=A THEN PSET(X,Y),B:GOTO 160
150 IF PT=B THEN PSET(X,Y),A
160 NEXT:NEXT:GOSUB 180:ZZ$=INPUT$(1):SCREEN 2:END
170 CLS:DEF SEG=&HB800:BLOAD A$+".PIC",0:RETURN
180 DEF SEG=&HB800:BSAVE A$+".PIC",0,64000!:RETURN
190 IF ERR=53 THEN PRINT "No picture files found!":RESUME 30
200 GOSUB 170:ZZ$=INPUT$(1):SCREEN 2:END
```

Listing 4. A GW-BASIC program which enables you to view fractals you've created on your Z150, and change their colors.

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count to 30, and again change the range by increments of 4.

Say that the grid was made up of the colors white, red and yellow. Then you know that those LAMBDA values need at least 110 iterations for the square of the size to reach 4. Knowing this, you might increase the count to 400. Since you know nothing happens until at least 110 iterations, your lowest color range line (line 250) would read:

```
IF COUNT=>0 AND COUNT<=120 THEN V=1
```

The remaining COUNT values would then be divided by the six remaining colors (400 - 120 = 280; 280/6 = 46). Try incrementing the range from 120 up to 400 by 46 units per color. By doing this a number of times, good COUNT values can be found, a color range that takes advantage of all the colors will be available, and a rough outline of the fractal object can be seen.

This takes time in itself, but it is better to spend the time here than on an entire display that may result in a small, colorful upper-left corner, with the rest of the screen blank.

Structural changes may also improve the speed. Compiling this program does noticeably improve the speed; unfortunately, the compiler does not support the BLOAD and BSAVE features. You will have to find some other means (such as an assembly-language subroutine) in order to save the image for viewing later.

Notes on the Z150 Listing

FRAC150.BAS (Listing 2) provides medium-resolution fractal displays. High-resolution monochrome displays can be generated by changing SCREEN 1 to SCREEN 2 in line 70; you must also delete the COLOR 0,2 command in line 70. And the color values for V in the COUNT lines must be changed to 0 and 7. (See monochrome display note in the body of the article.)

GW-BASIC (BASICA) saves all the color planes at once with the BSAVE command in line 270 (medium resolution), and BLOADs all the planes with the BLOAD command in line 330.

When plotting a second and third display, use PSET(N+105,M),V and PSET(N+210,M),V in line 130. (See Figure 2.)

"Parameter-space" vs. "dynamical-plane"

When I first wrote the FRACTAL.BAS program based on Dewdney's description, I misinterpreted a point. My program then led me into a world of fractal images that were quite different from the images shown in *Scientific American*.

Tracking down my problems (and going over Dewdney's program description more carefully), I received some very valuable help from Dr. John Hamal Hubbard, a mathematician at Cornell University. (He and pictures he had produced were mentioned in Dewdney's article.) Dr. Hubbard showed me that there are (at least) two types of fractal images: "parameter-space" and "dynamical-plane" images.

The main difference appears to depend upon how you treat C in the equation $Z^2 + C$. In the program given here, C is a complex number that remains constant during the iterations for a given pixel, but changes from one pixel to the next. As mentioned above, this produces a parameter-space fractal. In my original attempt, I kept the complex number C as a constant *throughout the entire program*. This produced a dynamical-plane fractal.

For those of you who wish to experiment with dynamical-plane images, here are the changes to make to the FRACTAL.BAS program listed here:

Change line 160:

```
AX=AZ^2-BZ^2+AC:
```


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Fractal Image Contest

Enter the Fractal Image Contest and try for the chance to have your graphic image and program featured in an upcoming issue of *Sextant*. The generation program can be the one that appears here, a modification of the program, or your own Z-BASIC or GW-BASIC program. Send a disk copy of your program and displayable picture file(s) to:

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```
BX=2*AZ*BZ+BC:
AZ=AX:BZ=BX:
SIZESQ=AX^2+BX^2
to:
AZ=AC^2-BC^2+ACORNER:
BZ=2*AC*BC+BCORNER:
AC=AZ:BC=BZ:
SIZESQ=AC^2+BC^2
```

Then make the maximum value of COUNT equal to 350, and increment the color range by 25 units. You will have to add more lines in the color range group. Then, from the top down, assign the colors in an order similar to the following: 6, 4, 7, 1, 7, 2, 5, 2, 4, 6, 4, 1, 7, 1. Two excellent areas to explore are -1.255+.0255i, with SIDE equal to .25, and -.55+.5i, with SIDE equal to .15.

Other initial equations

Many different initial equations can be used for the dynamical-plane fractal images: $Z = Z^2 + C$, where C is the constant initial LAMBDA; $Z = Z^2 - 1$; $Z = Z^3 - Z + 1$; and the exponential function $Z = e^Z$.

For parameter-space images, you could try $Z = Z^2 + C$ where C is a variable form of LAMBDA. Or you could use an exponential, as in $Z = C * e^Z$.

The possible fractal displays are as varied as the points in the complex plane. Armed with your imagination, patience, and time, you have all the supplies needed for the journey. Here's hoping you find the image you've been looking for.

For Further Reading

Paul W. Carlson, "IBM Fractal Graphics," *Compute!*, Iss. 70, Vol. 8, No. 3 (March 1986), pp. 78-80.

Monte Davis, "Benoit B. Mandelbrot (an interview)," *Omni*, February 1984, pp. 65-66, 102-107.

A. K. Dewdney, "Computer Recreations," *Scientific American*, Vol. 253 (August 1985), pp. 16-24.

Charles Jackson, "Fractal Zoom," *Antic*, Vol. 4, No. 12 (April 1986), pp. 16-20.

Benoit Mandelbrot, *The Fractal Geometry of Nature*. New York: W.H. Freeman and Company, 1982.

M. van de Panne, "3-D Fractals," *Creative Computing*, Vol. 11, No. 7 (July 1985), pp. 78-82.

Peter R. Sorensen, "Fractals," *Byte*, Vol. 9, No. 10 (September 1984), pp. 157-172.

Kathleen Stein, "The Fractal Cosmos," *Omni*, Vol. 5, No. 5 (February 1983), pp. 62-71, 115.

S. Weisburd, "Fractals, Fractures and Faults," *Science News*, (May 4, 1985) p. 279. △

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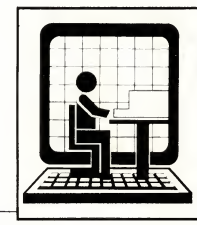

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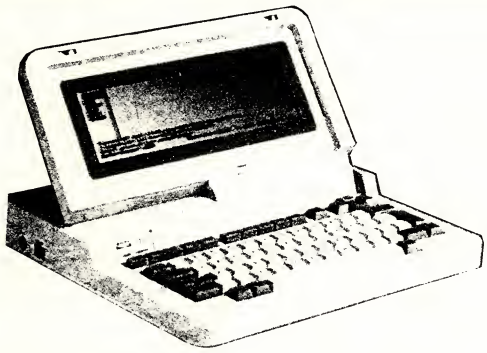

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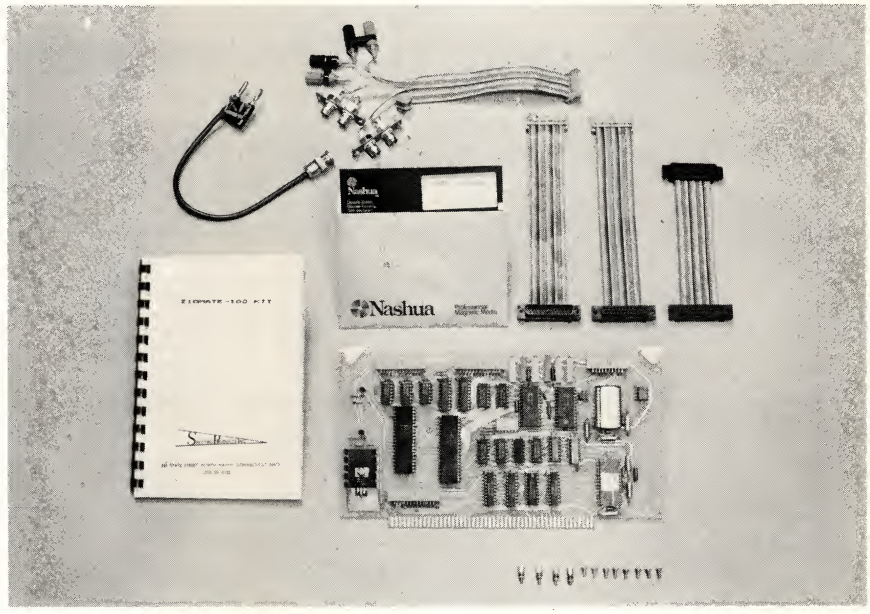

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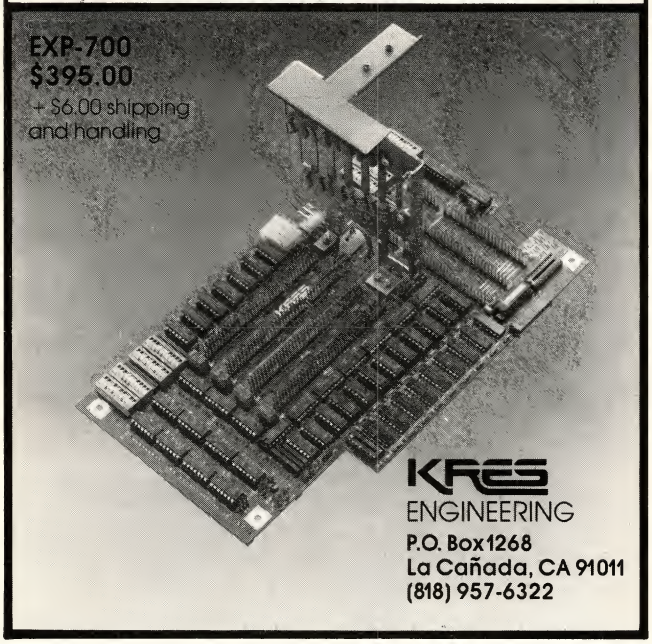

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Scuttlebutt

We've picked up a few postscripts to last issue's coverage of the Western Regional Heath/Zenith Users' Group Conference. While the HUG staff was flying home toward Michigan, Bob Ellerton was awakened from a nap by a **flash of lightning** which struck the plane. That, plus the fact that the aircraft didn't quite make it to the runway on the first attempt, convinced some on board to drive to HUG conferences in the future.

Zenith continues the multifaceted activity of seeking government contracts. Last winter, they successfully **protested bidding terms** set by the Secret Service. Before ZDS complained that the requirement was unreasonable, the agency was asking prospective suppliers to include PC-DOS in their offerings.

HDOS 3 may be ready in time for the International Heath/Zenith Users' Group Conference August 15-17, 1986. If not, word is that the author dares not show up at the Hyatt Regency O'Hare. Admission to conference seminars and exhibits costs $10, but for $25 you can get all that plus some food and a chance at the **door prizes**. The conference is being run by the Heath/Zenith Users' Group, Hilltop Road, St. Joseph, MI 49085, 616/982-3463. Please don't bother them with questions about HDOS!

The big news at our office is the new refrigerator that draws only half as much current as the old one. We need **all the watts we can get** for our computers and air conditioners. Technical Editor John Walker should be able to cut way back on summer trips to the basement to replace fuses.

Have a hard disk, floppy disk, or tape that's been damaged so you can't get at the data? The folks at Data Protection Services claim they can help even if some of the **oxide coating** has been scraped off. They're at 1507 East 7 St., Tulsa, OK 74120, 918/496-3475.

Comparing the Z100 screen display on the cover with the Z150 screen on page 79 suggests there are times when it's nice to have **twice as many** colors and twice as many pixels.

It was almost four months after Jennie Allen left *Sextant* before I got around to taking her advice to use slide film for Z100 **screen photography**. It turned out to be easier than I expected. In order to see right away how the slides turned out, I used Polaroid's Polachrome 35mm film. That did take a few minutes longer to develop than the Kodamatic instant prints we used to use.

The Z150 picture didn't require a camera. We just sent a **disk file** out to California, and back came four negatives—one for each color of ink used on the printing press.

The Western Regional HUG Conference has been set for November 14-16 at the **Disneyland Hotel**. We expect to have details in time for the September-October issue. Or write WRHUGCON at 1555 North Orange Grove Ave., Pomona, CA 91767.

Debi Peel has joined us during her summer vacation from Wellesley College. We have an unusually varied group of activities in store for her—our only **summer assistant** this year. During Debi's first three days, she got to open the mail, stuff envelopes, and work on a major marketing project.

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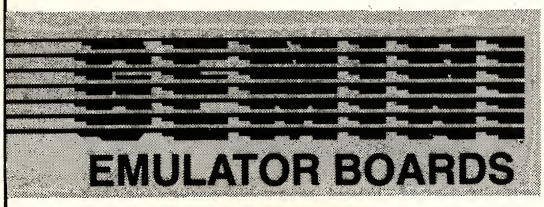

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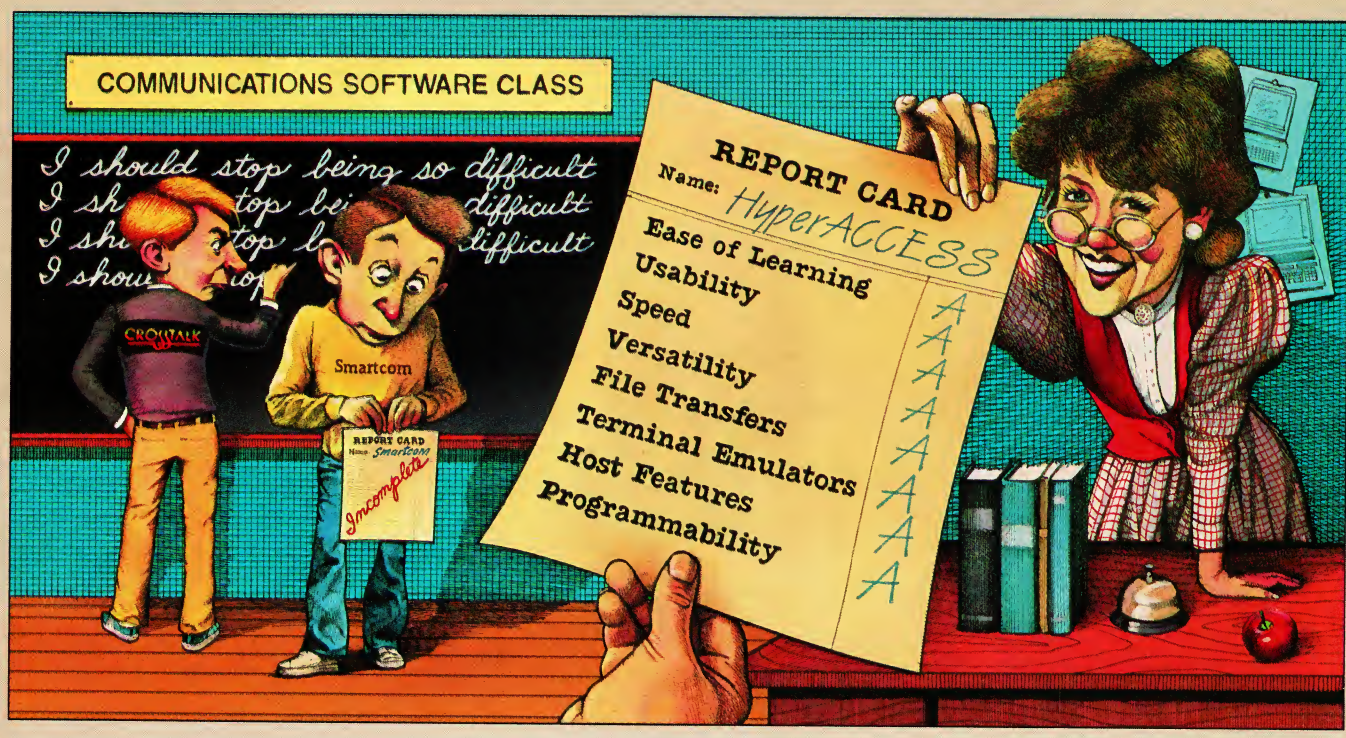

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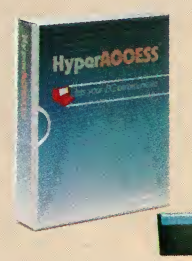

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